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(54) **FASTENER WITH DISCRETE HEAD CAP**

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(73) Assignee: **MCGARD LLC**, Orchard Park, NY (US)

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***F16B 33/00*** (2006.01)

(52) **U.S. Cl.**

CPC ..... ***F16B 37/14*** (2013.01); ***F16B 33/00*** (2013.01)

USPC ..... **411/373**; 411/429

(57) **ABSTRACT**

A threaded fastener comprises a fastener body having a threaded portion, a tool engaging surface, and a head cap receiving bore. The head cap receiving bore has a head cap bearing surface and a head cap retaining surface. A head cap has a rigid base and a central stem extending from the base. The head cap stem is disposed in the head cap receiving bore. The head cap base has a body bearing surface in contacting or near-contacting engagement with the head cap bearing surface. The head cap base further has a head cap outer surface. A head cap retainer interconnects the head cap stem and head cap retaining surface. The head cap retainer comprises a material of sufficient strength and rigidity to retain the head cap on the fastener body in a high-strength, axially non-deformable interconnection that holds the head cap in a substantially fixed and immovable axial position.

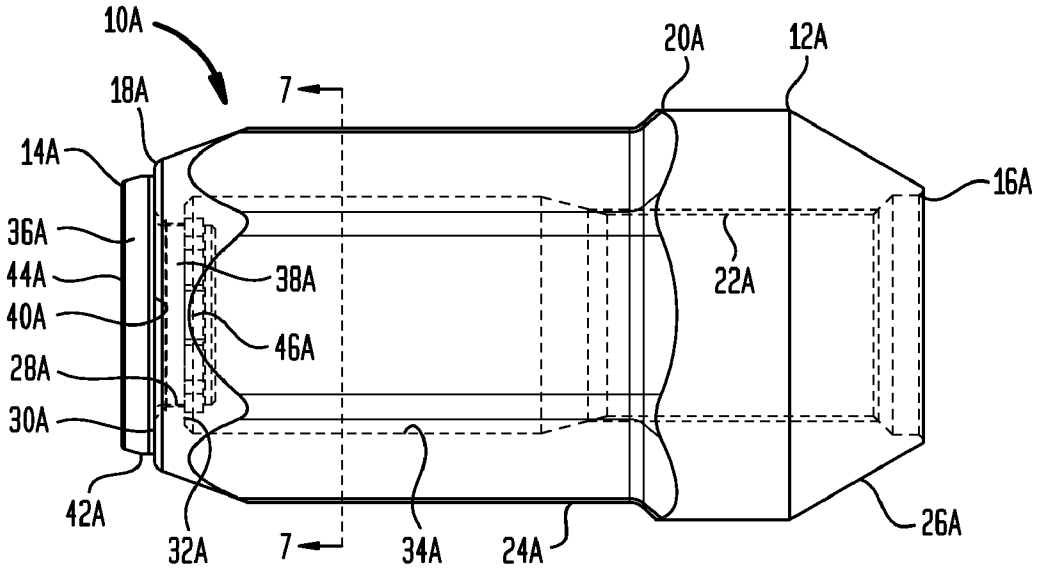


FIG. 1

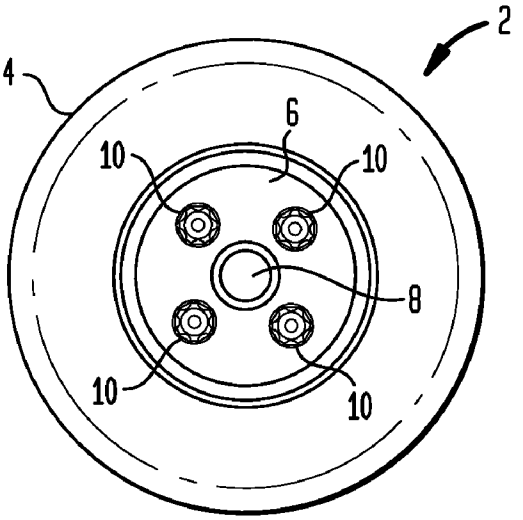



FIG. 2

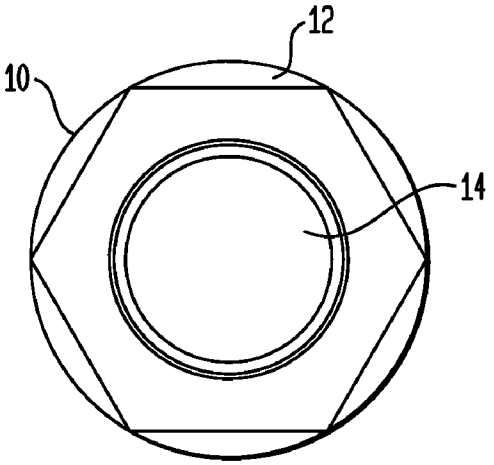



FIG. 3

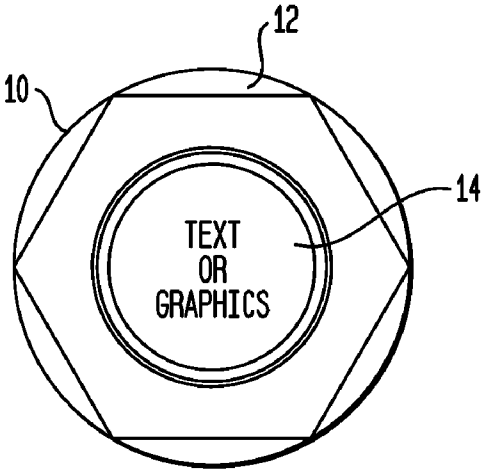


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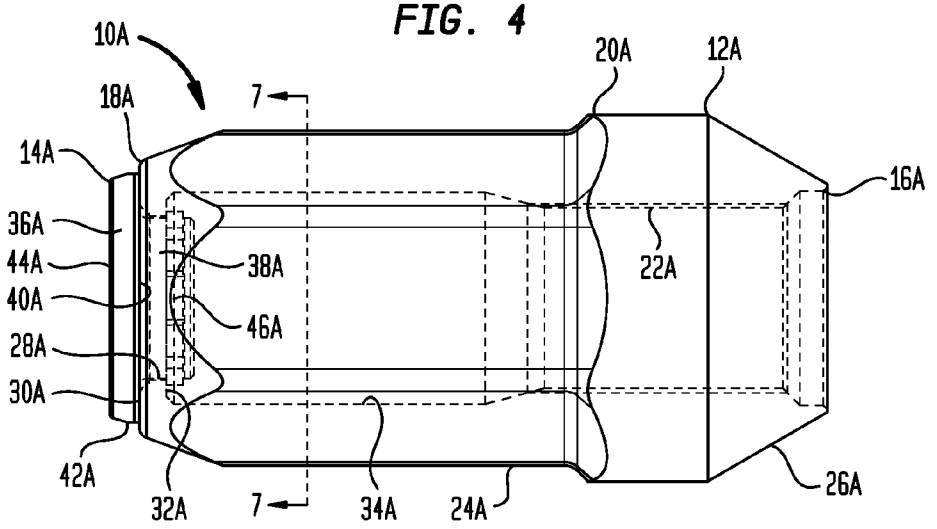



FIG. 5

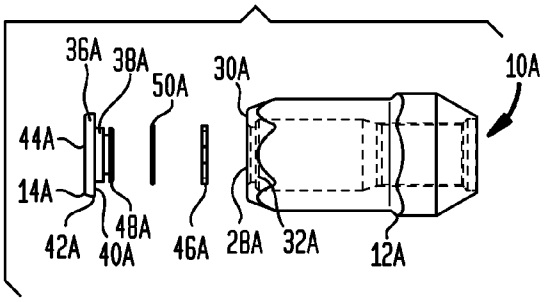



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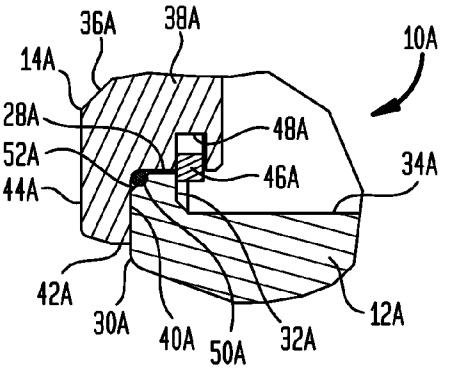



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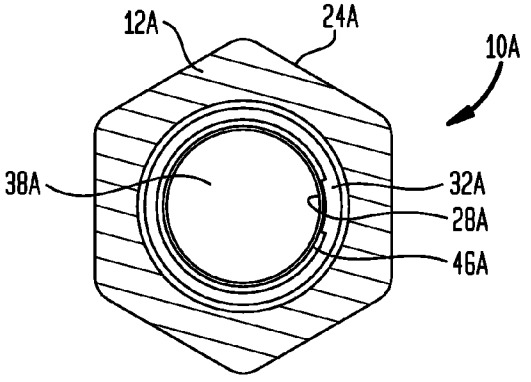


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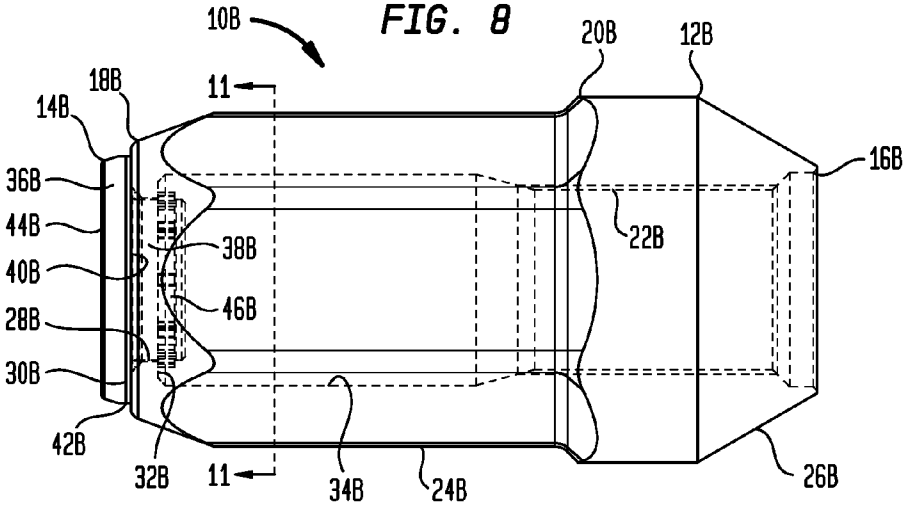



FIG. 9

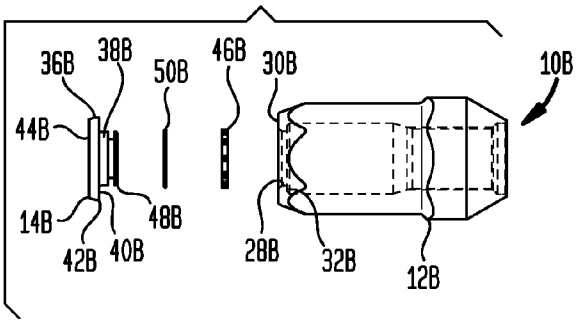



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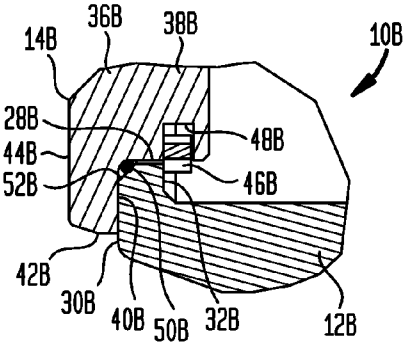



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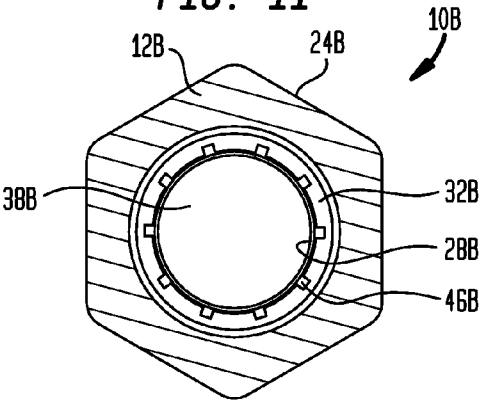


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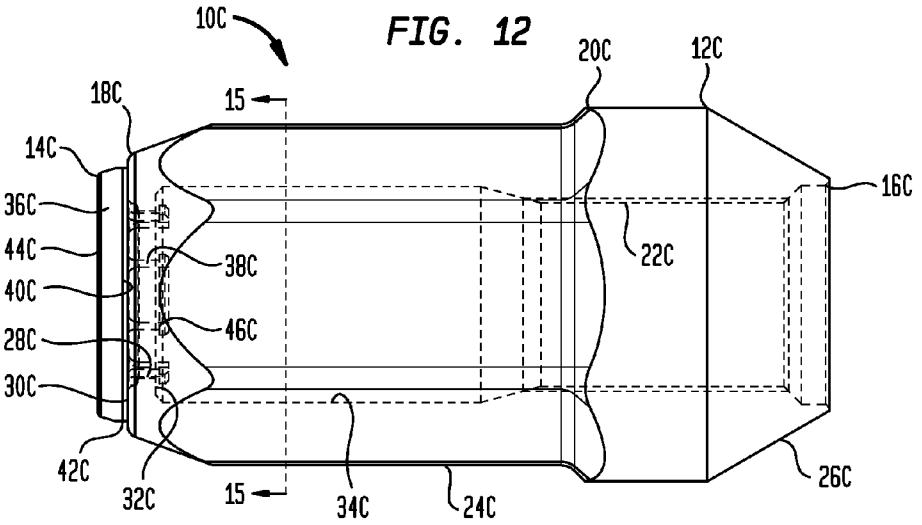



FIG. 13

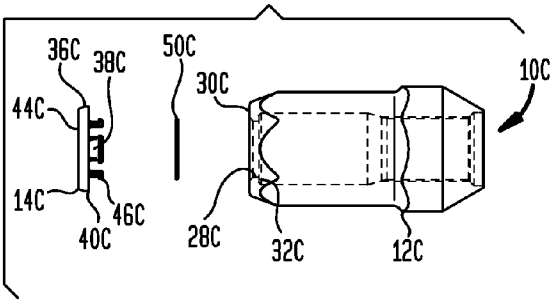



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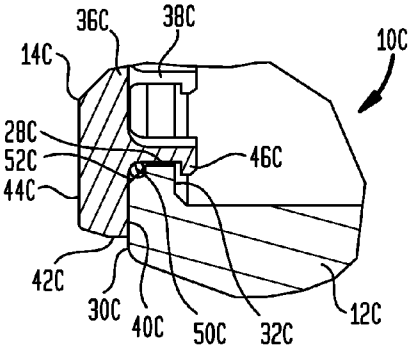



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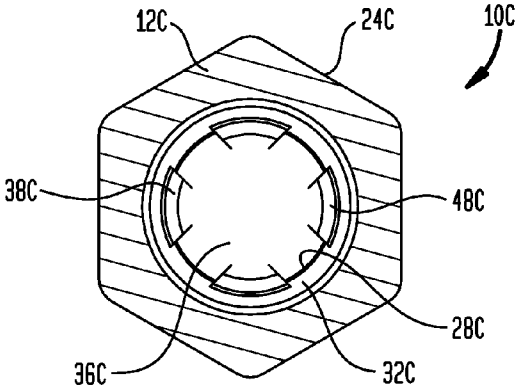


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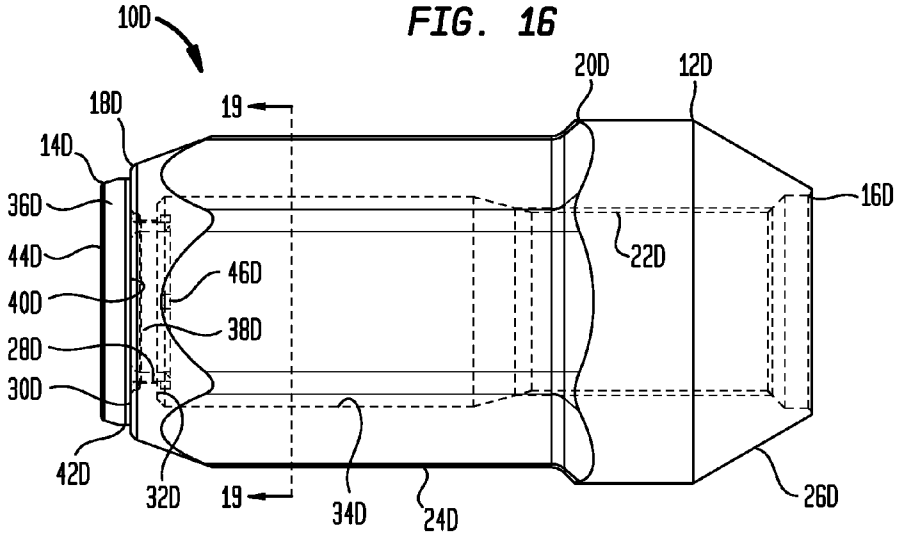



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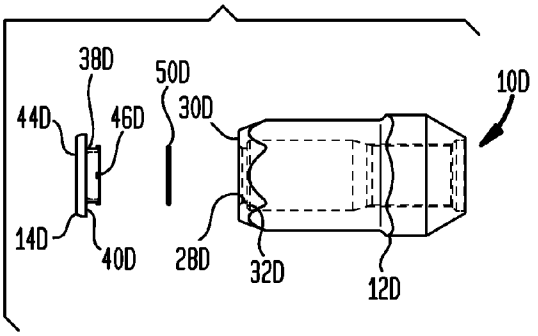



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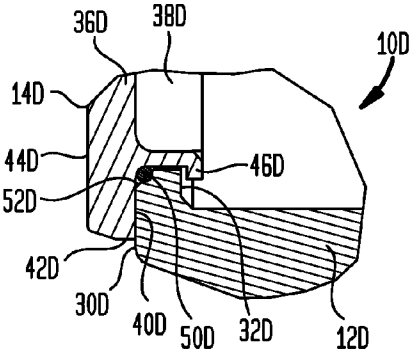



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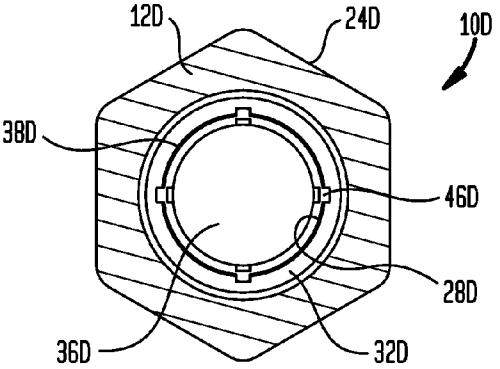


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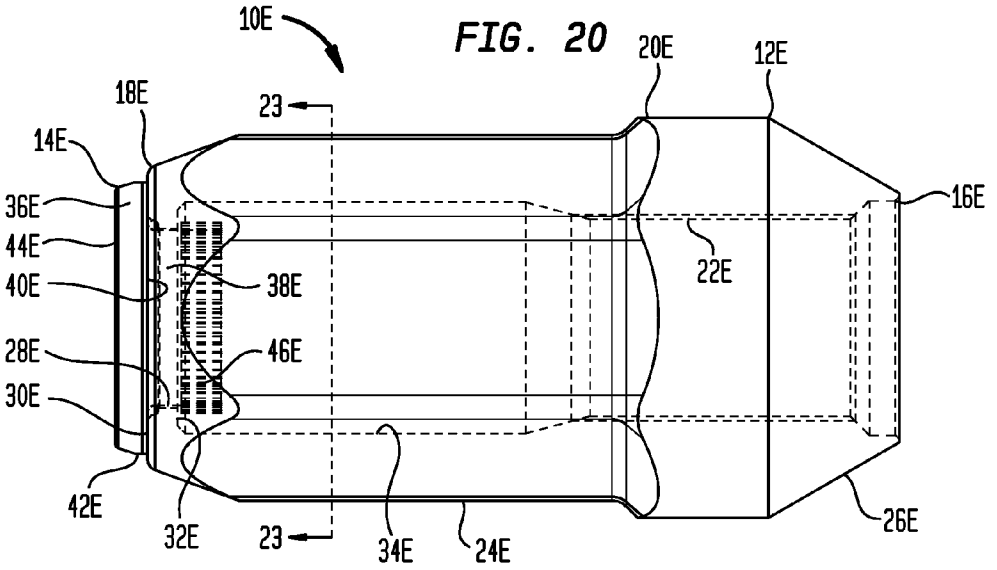



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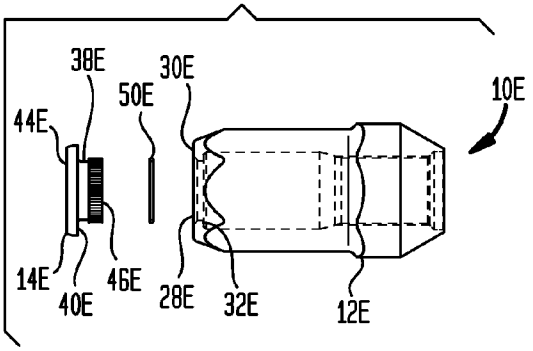



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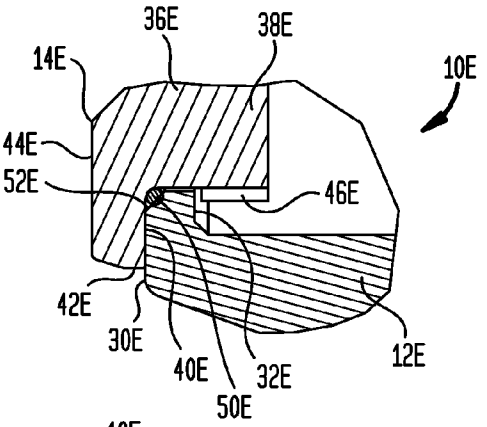



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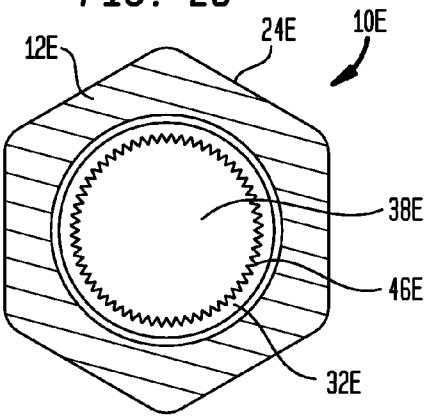


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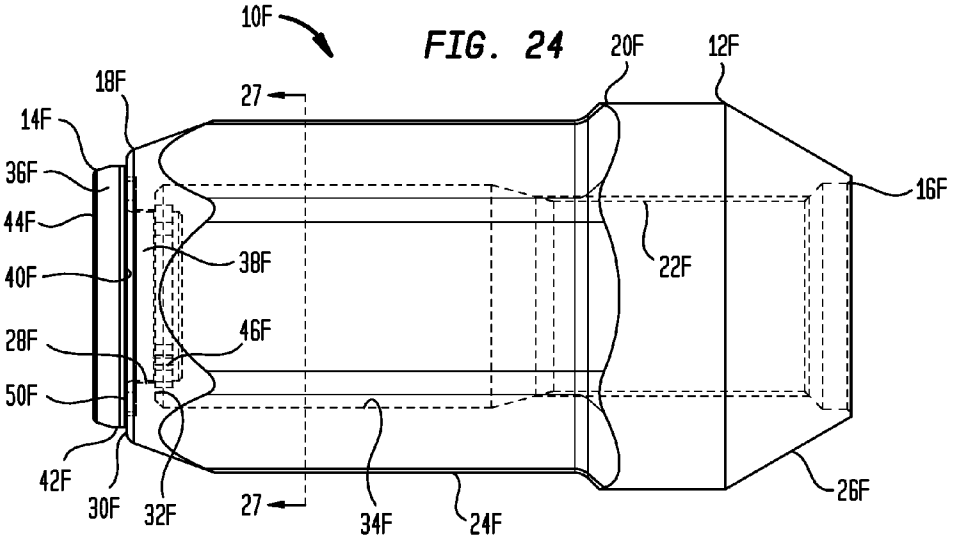



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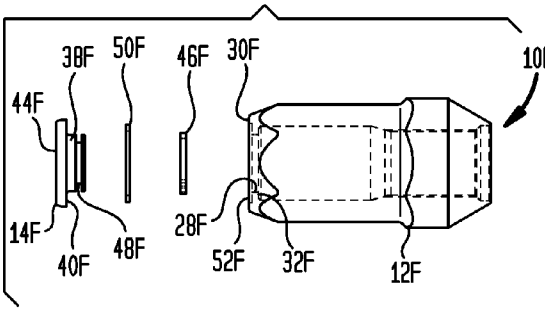



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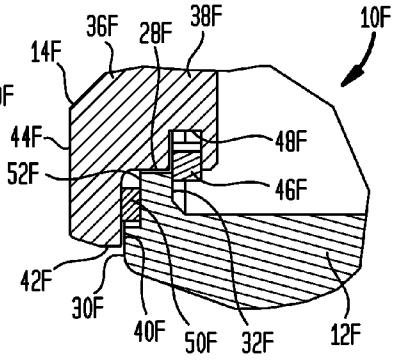



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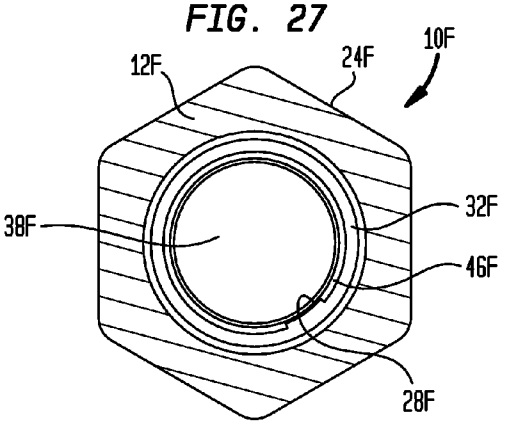


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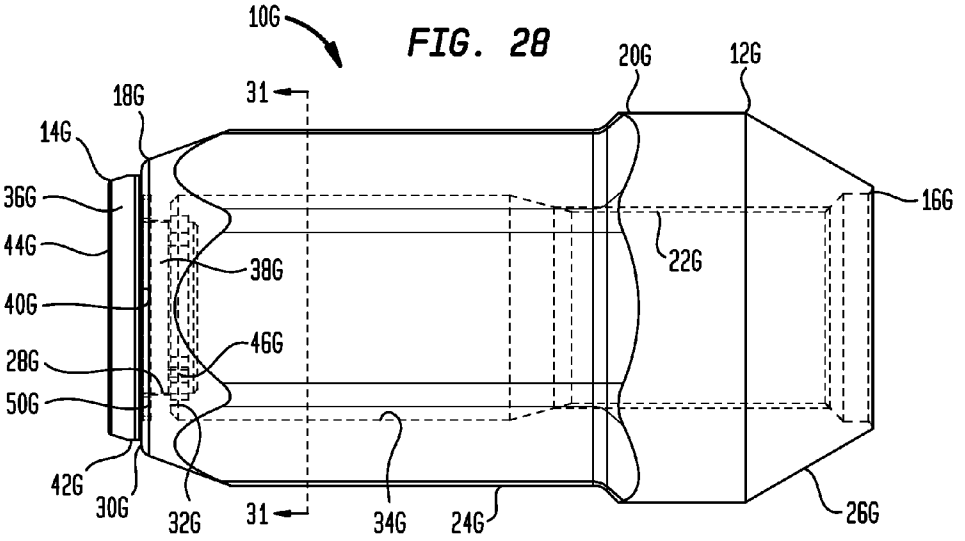



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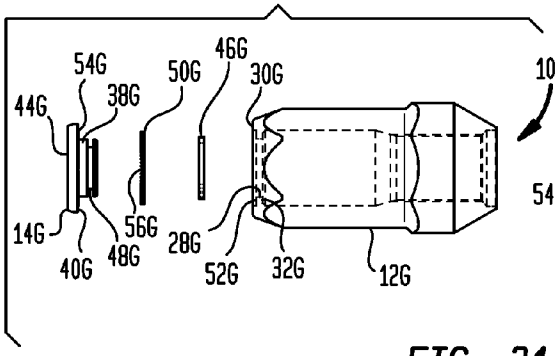



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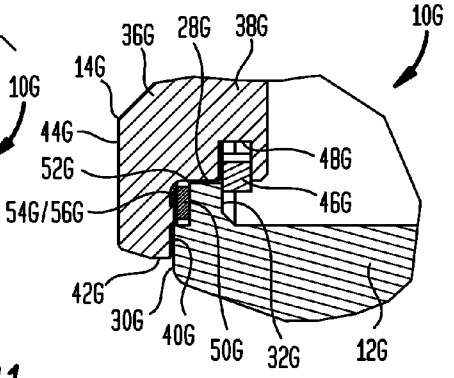



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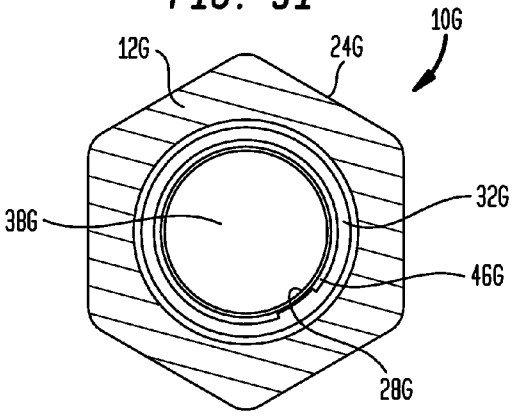


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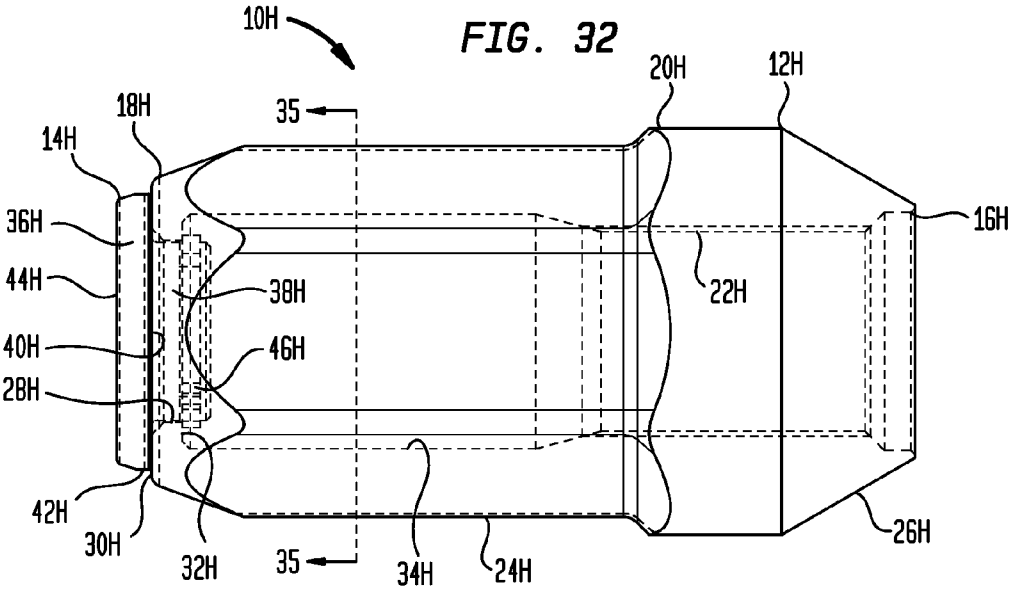



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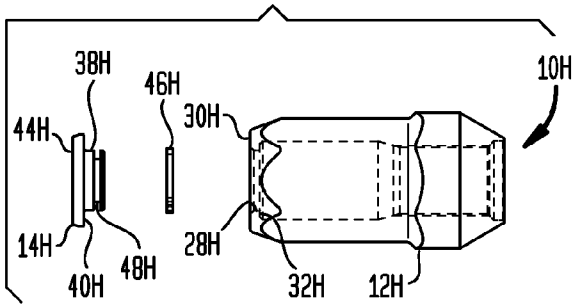



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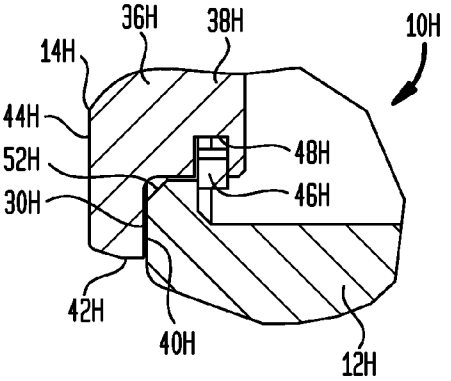



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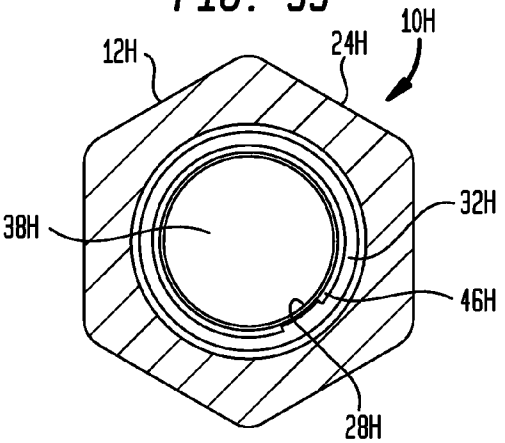


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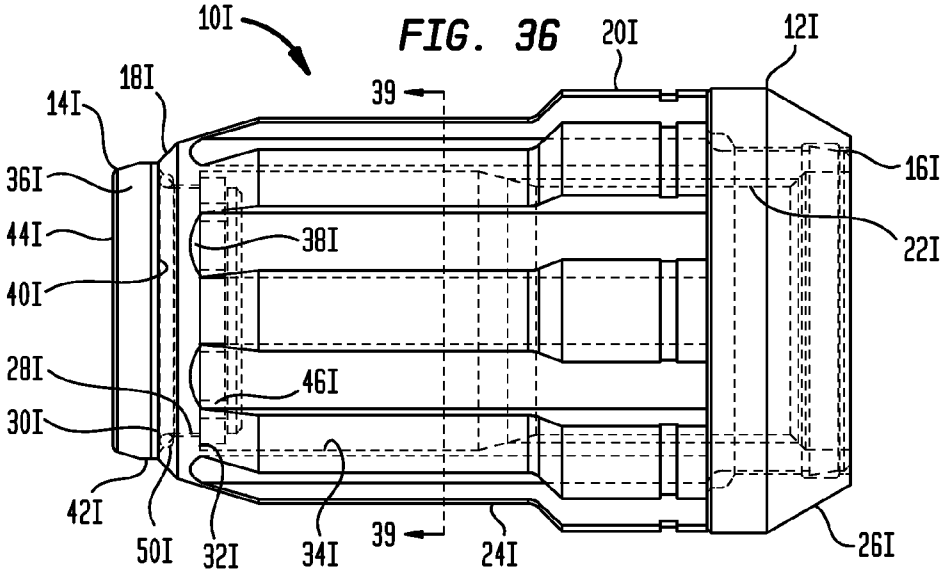



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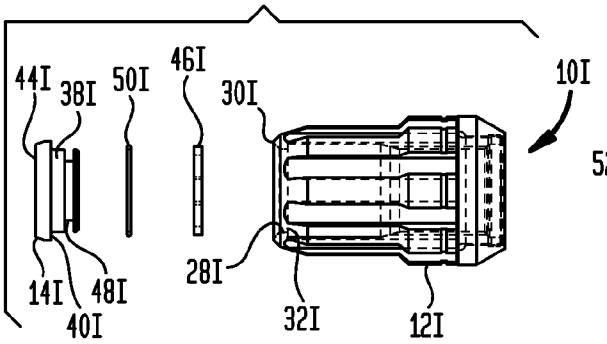



FIG. 38

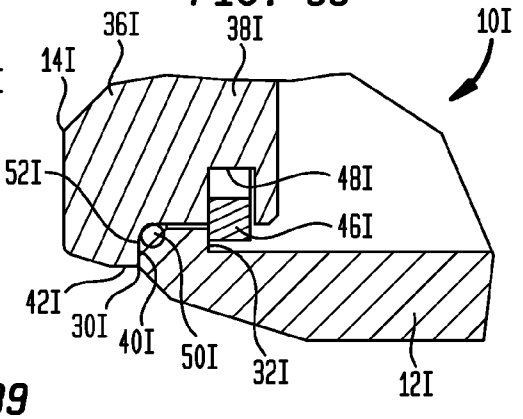



FIG. 39

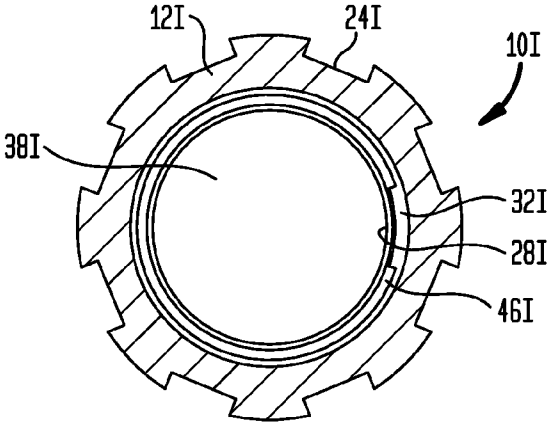


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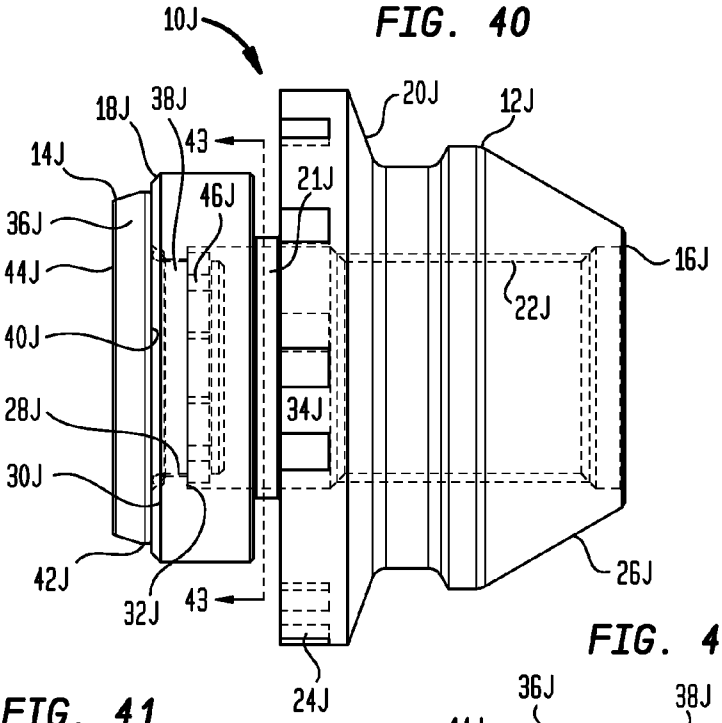



FIG. 41

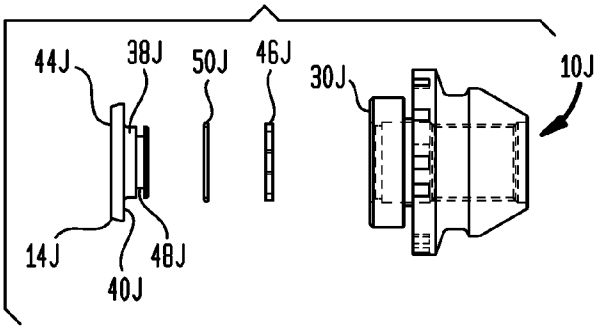



FIG. 42

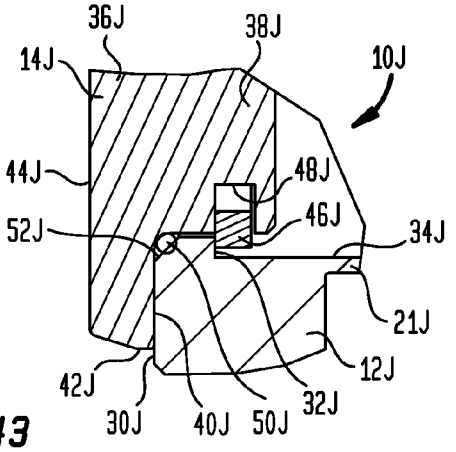



FIG. 43

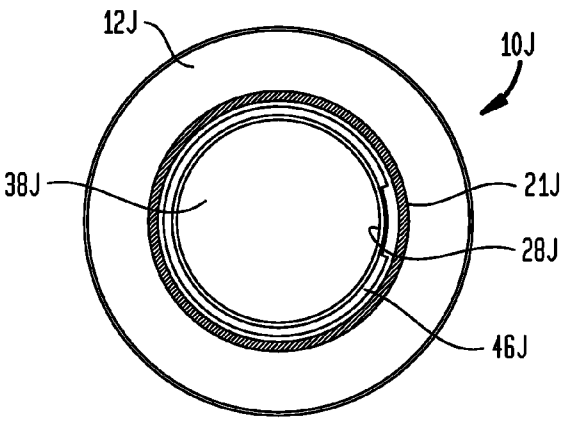


FIG. 44

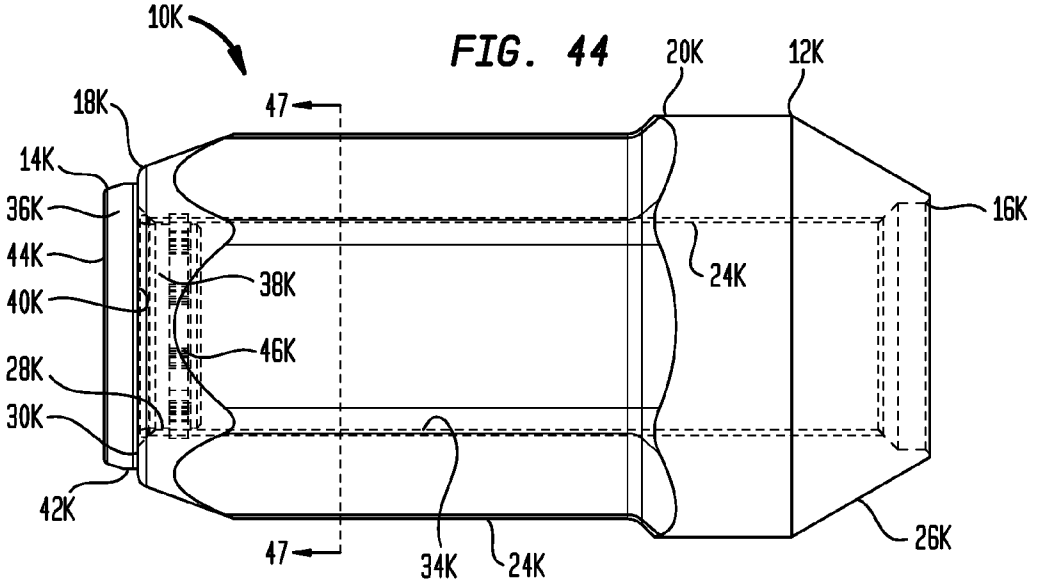



FIG. 45

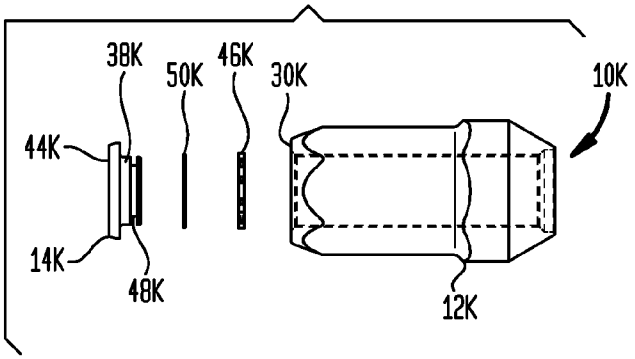



FIG. 46

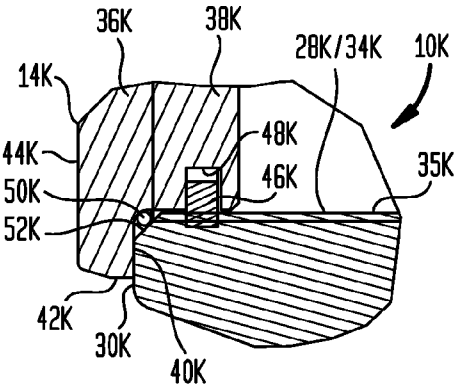



FIG. 47

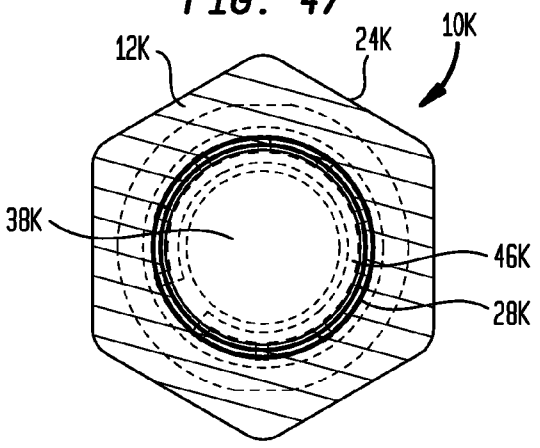


FIG. 48

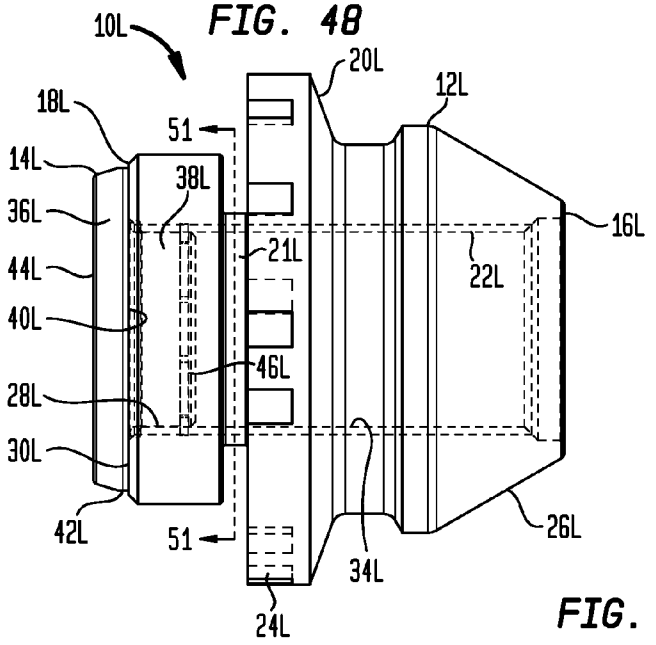



FIG. 49

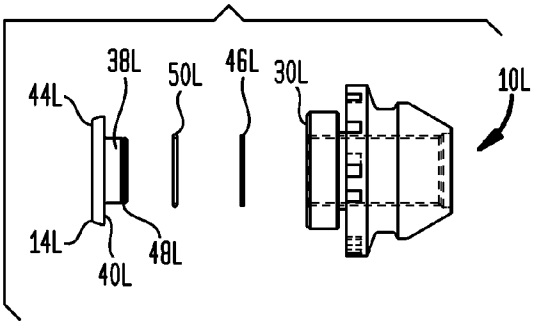



FIG. 50

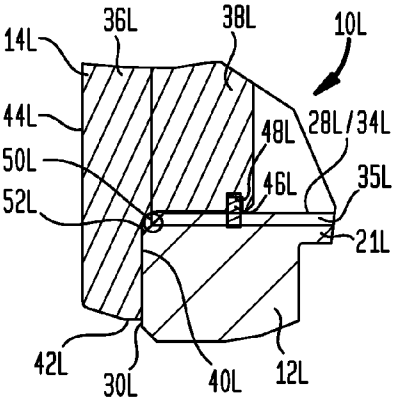



FIG. 51

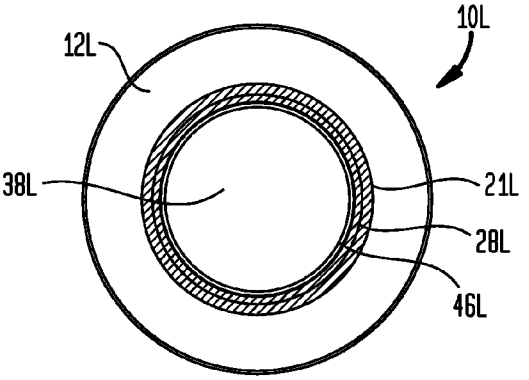


FIG. 52

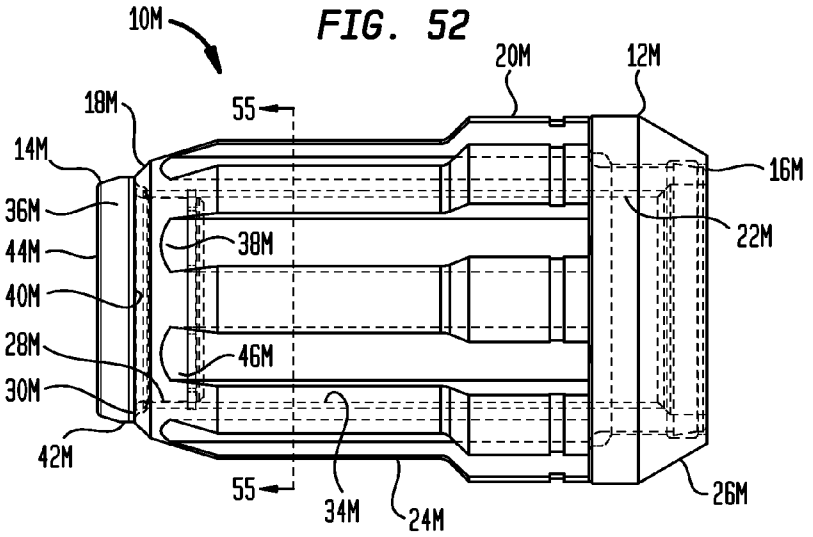



FIG. 53

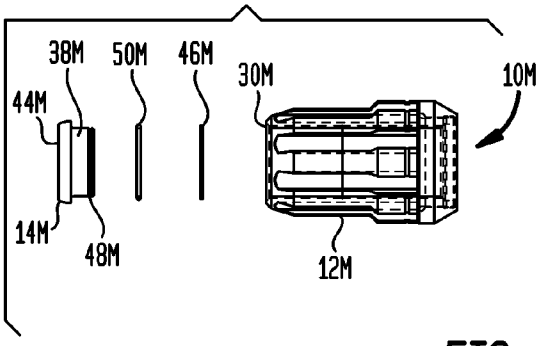



FIG. 54

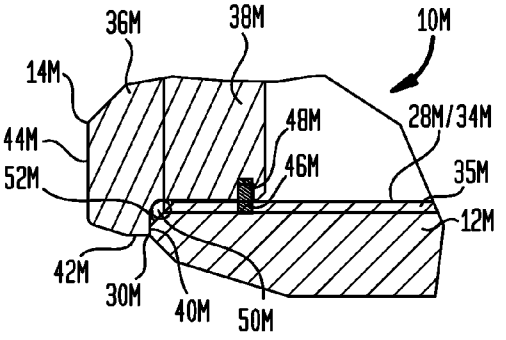



FIG. 55

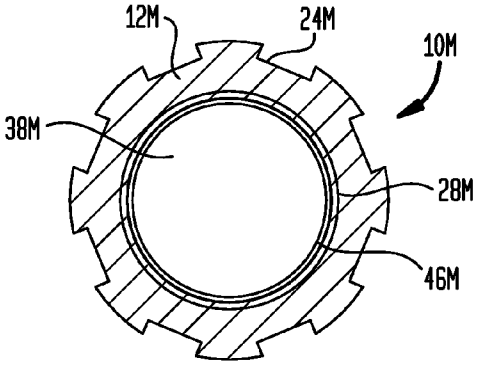


FIG. 56

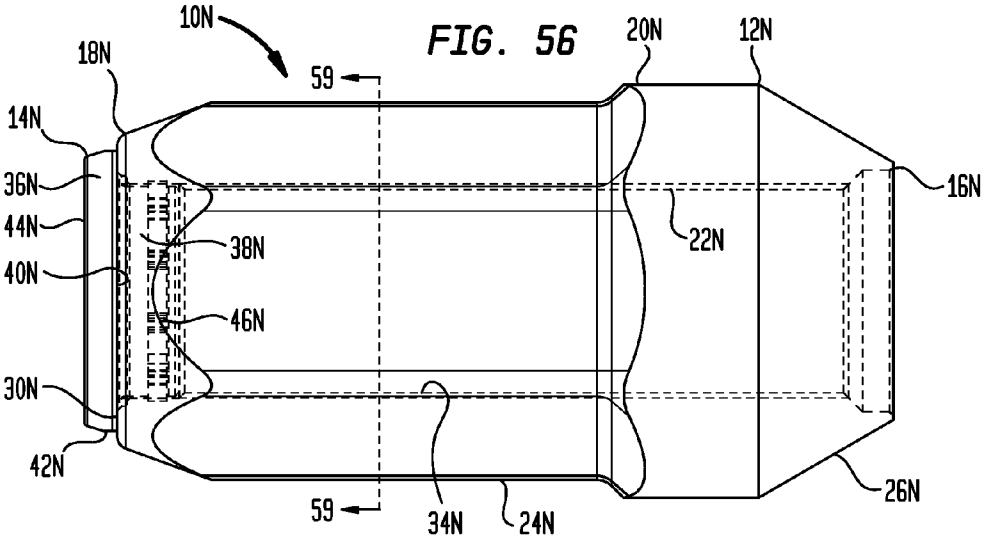



FIG. 57

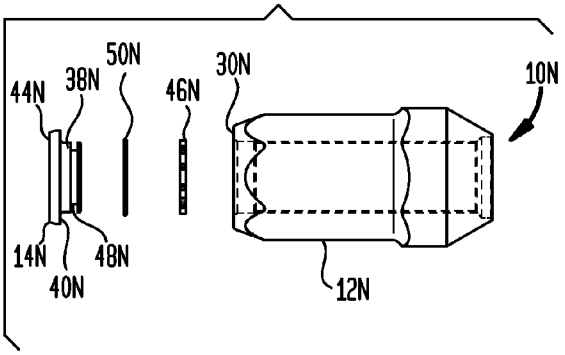



FIG. 58

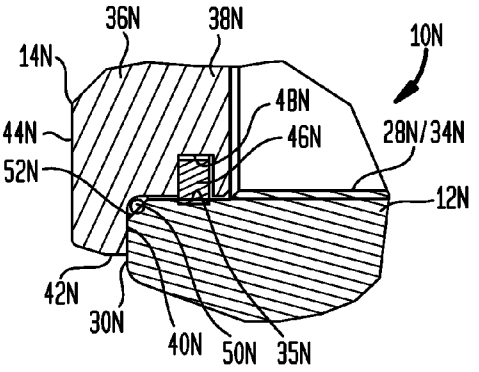



FIG. 59

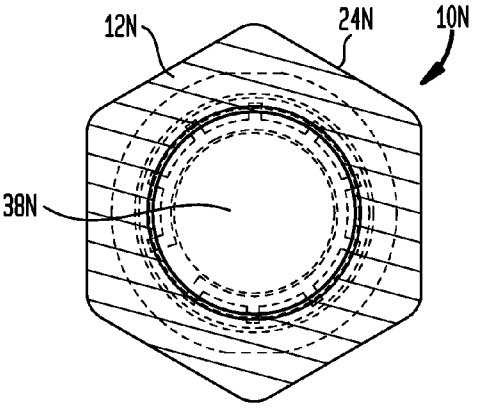


FIG. 60

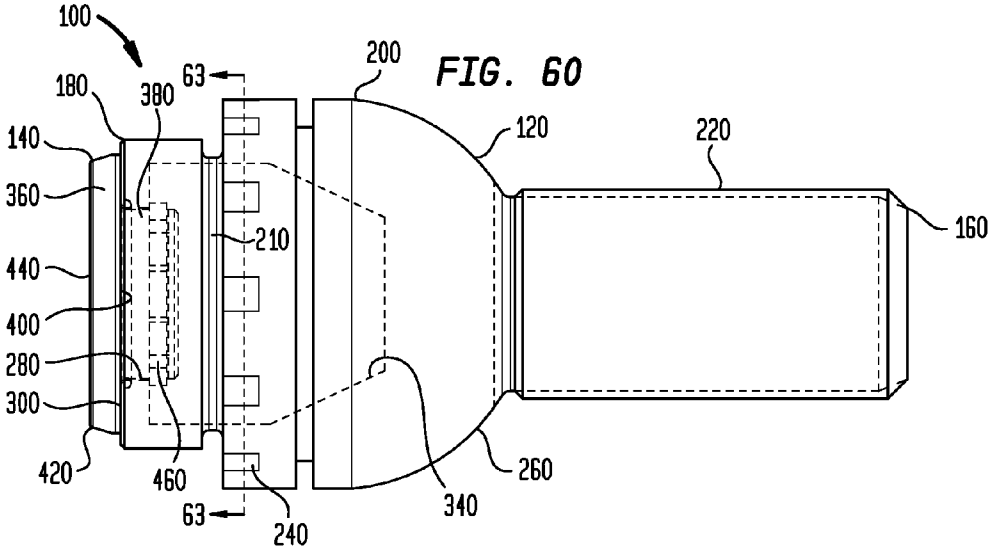



FIG. 61

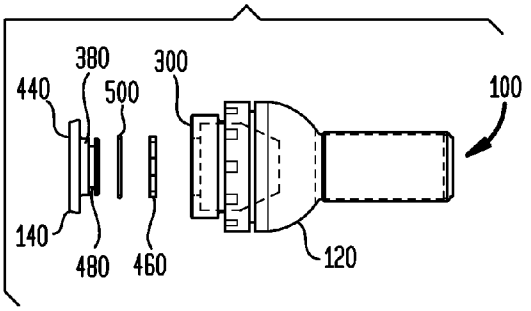



FIG. 62

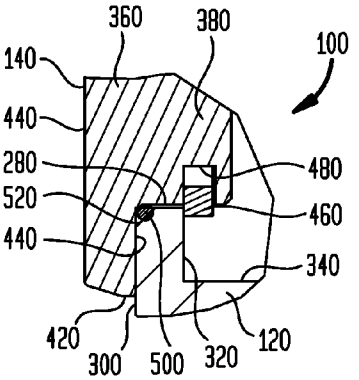



FIG. 63

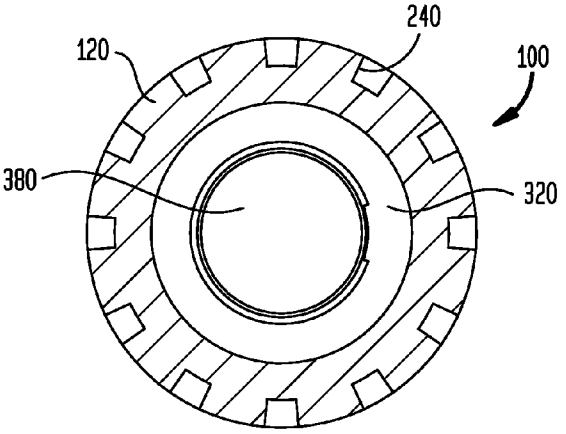


FIG. 64

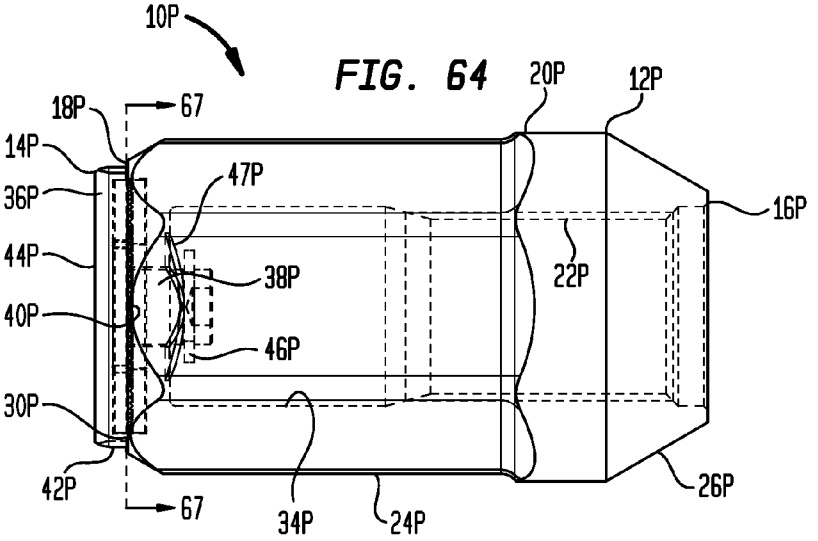



FIG. 65

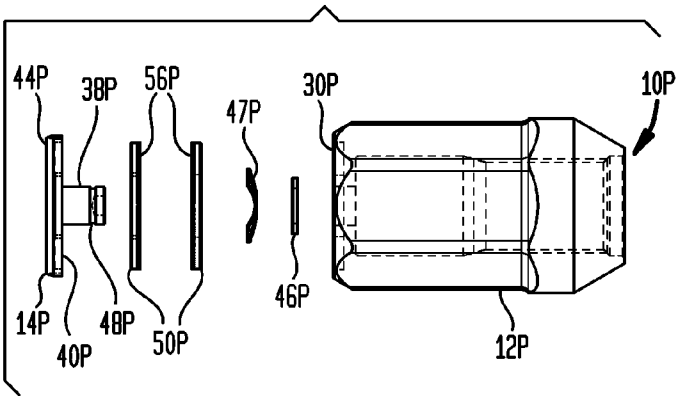



FIG. 66

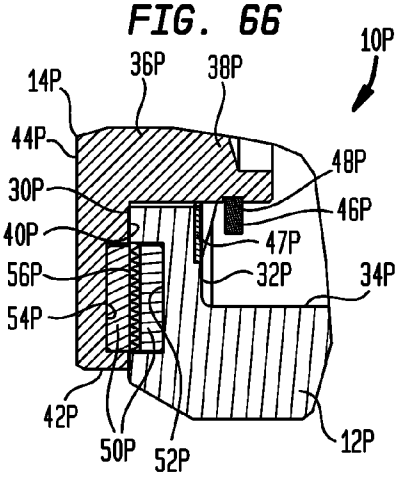



FIG. 67

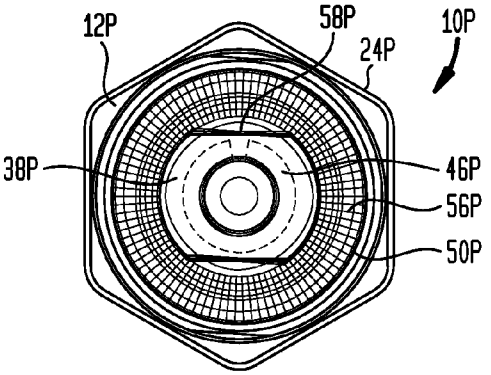


FIG. 68

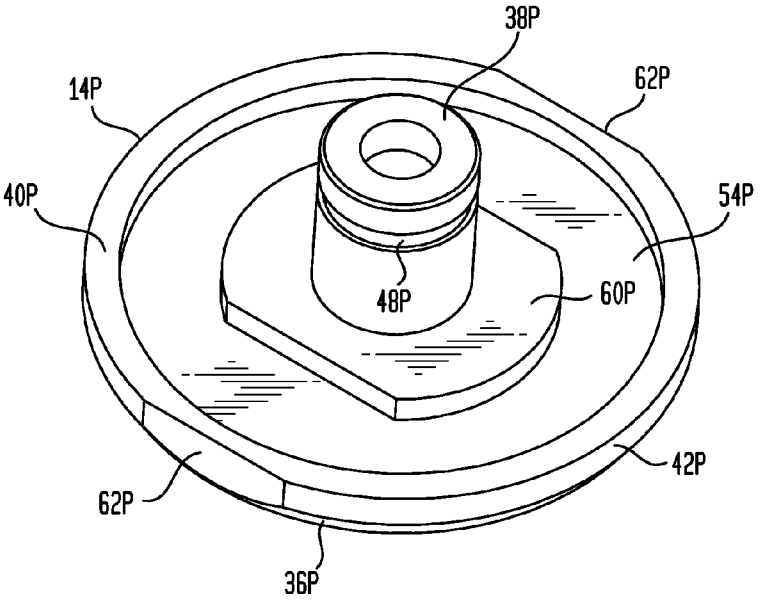



FIG. 70

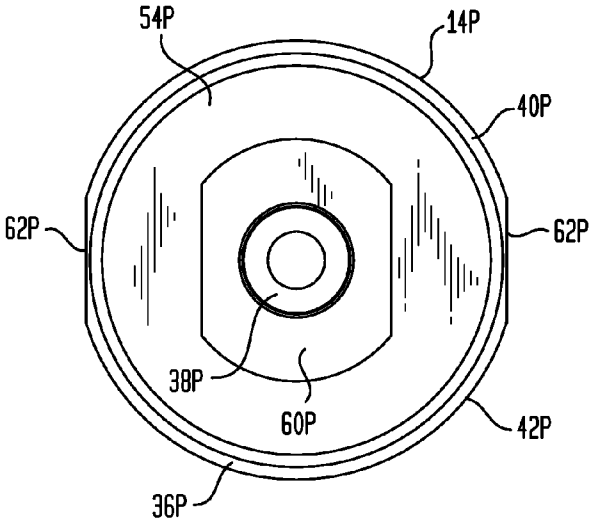



FIG. 69

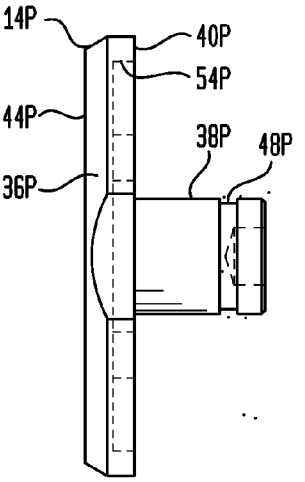


FIG. 71

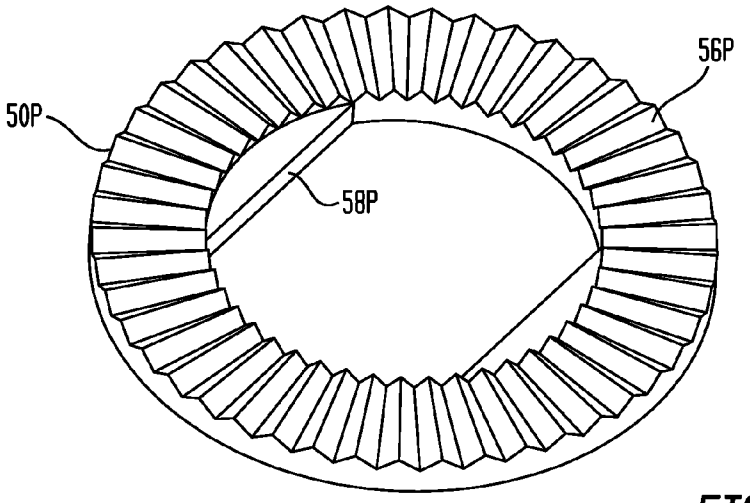



FIG. 73

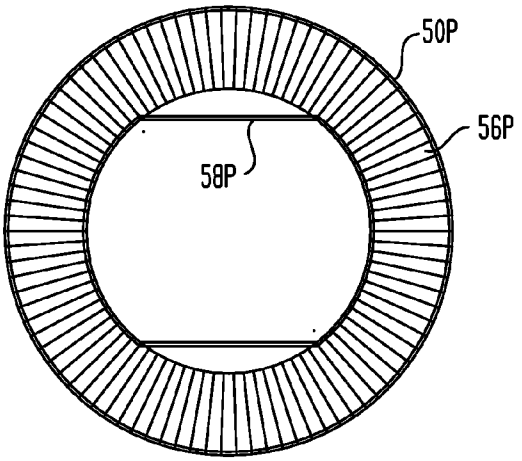



FIG. 72

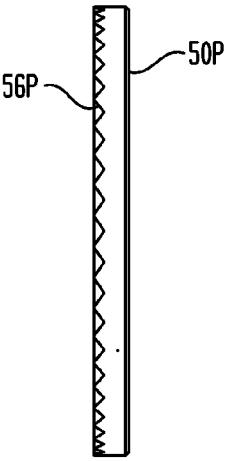



FIG. 74

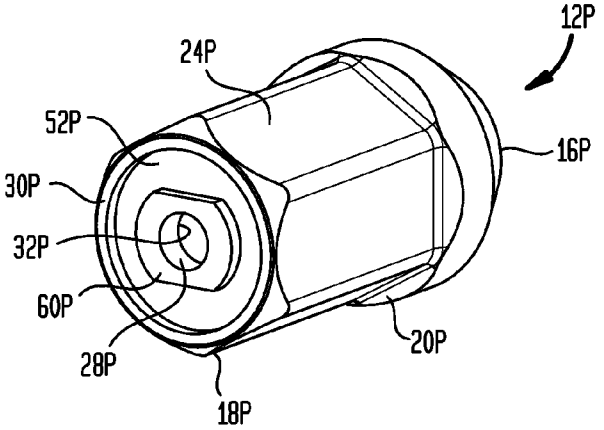


FIG. 75

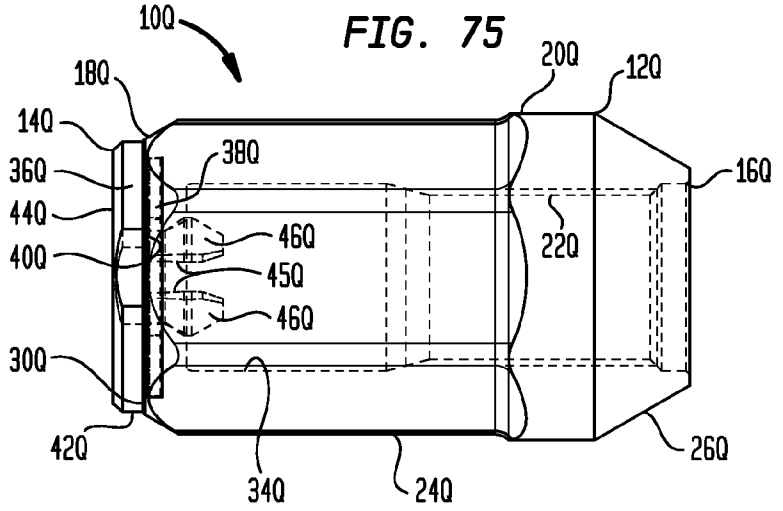



FIG. 76

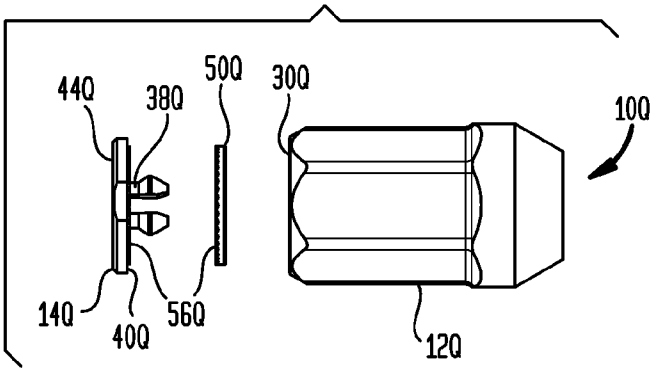



FIG. 77

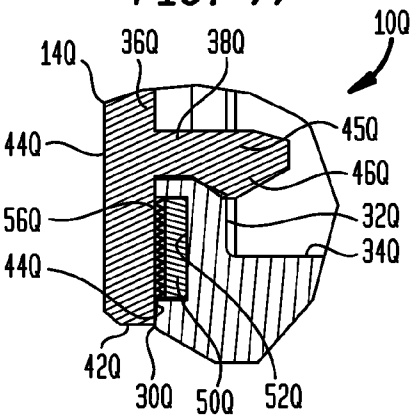


FIG. 78

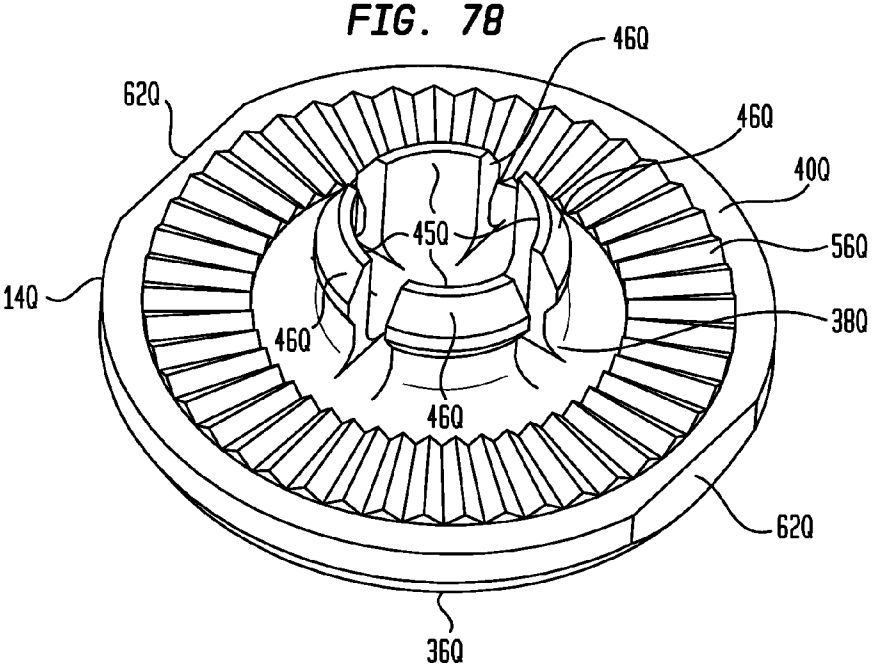



FIG. 80

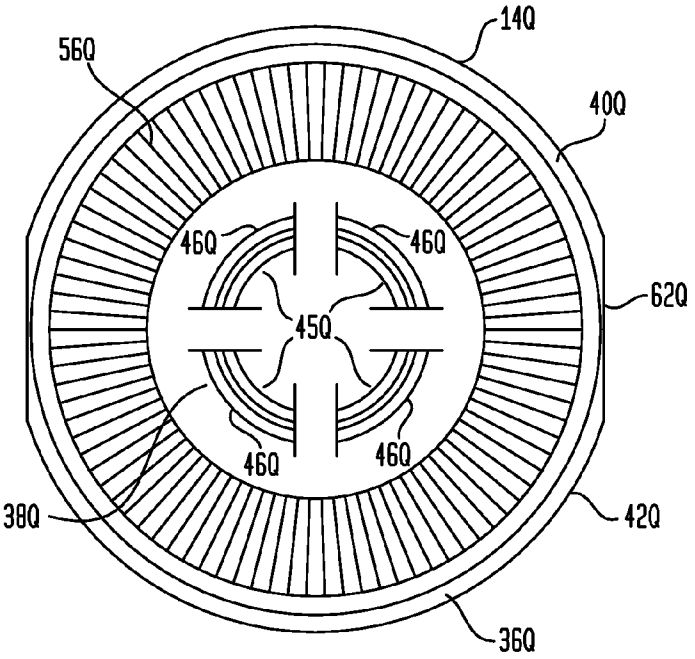



FIG. 79

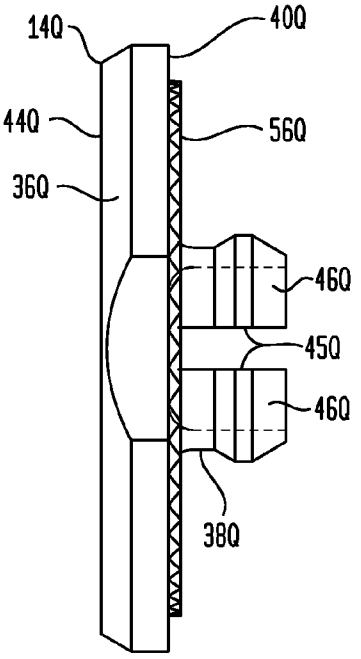


FIG. 81

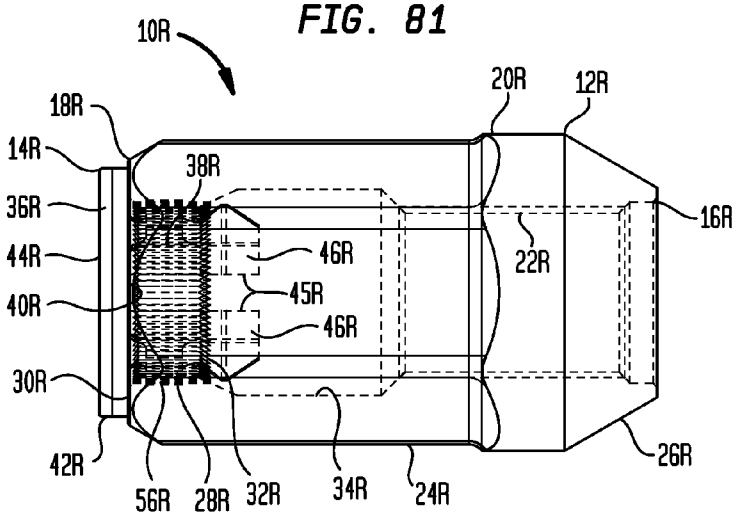



FIG. 82

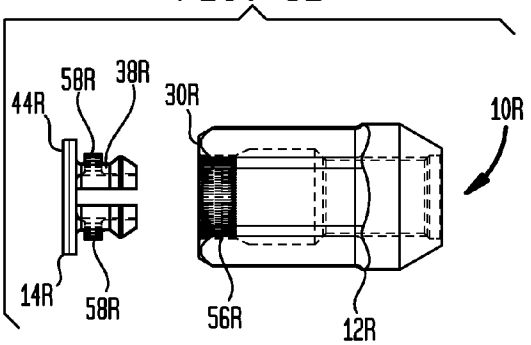



FIG. 83

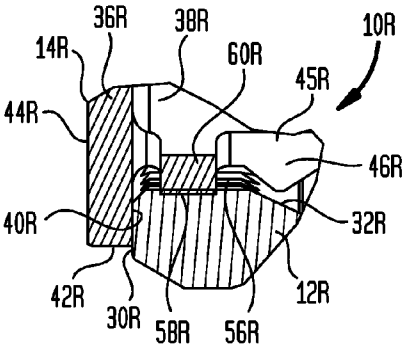


FIG. 84

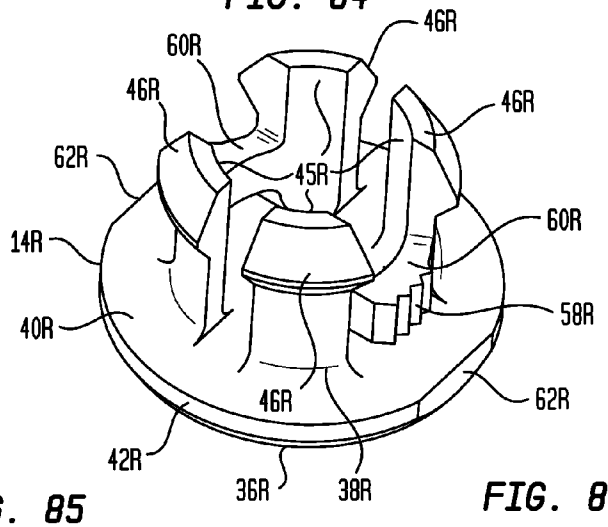



FIG. 85

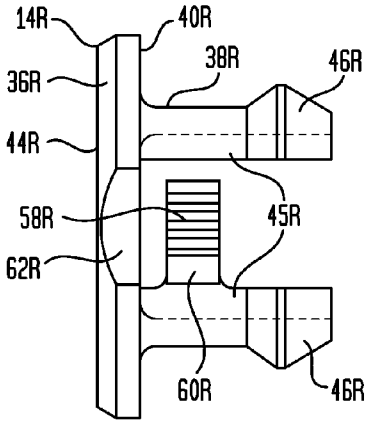



FIG. 86

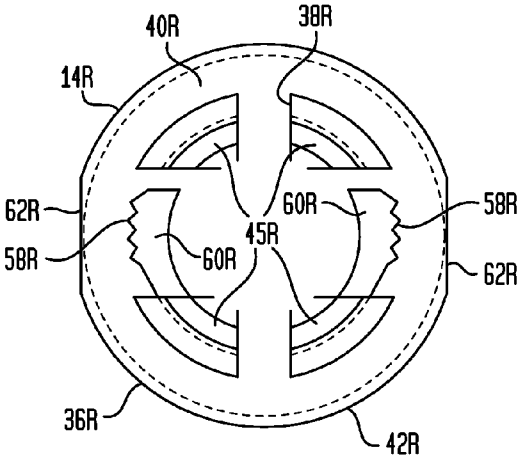



FIG. 87

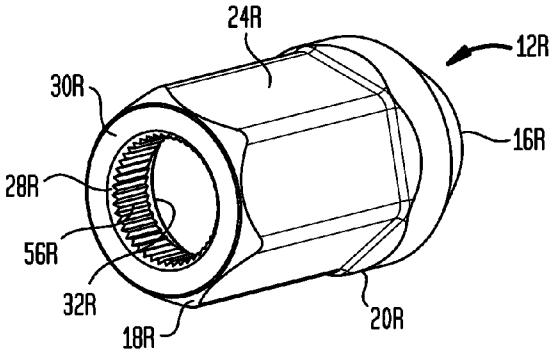


FIG. 88

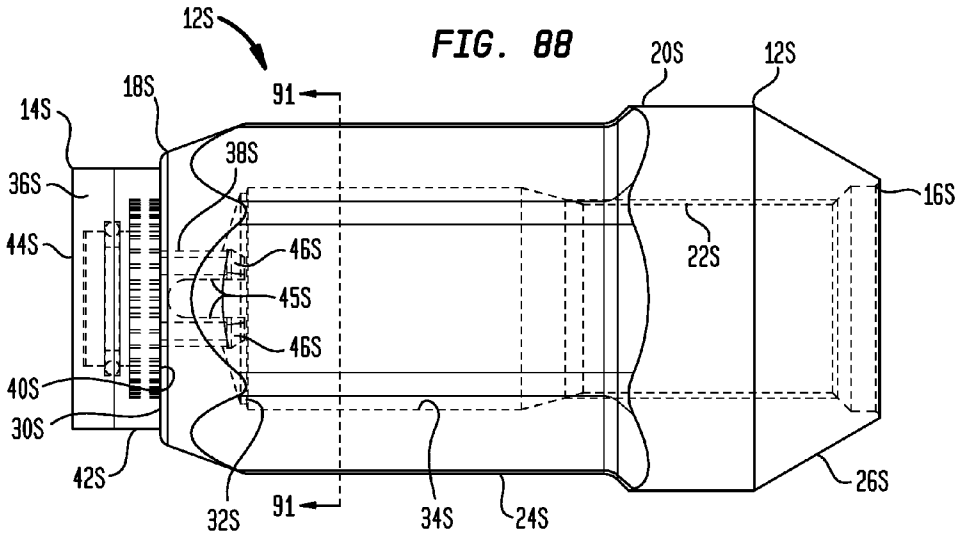



FIG. 89

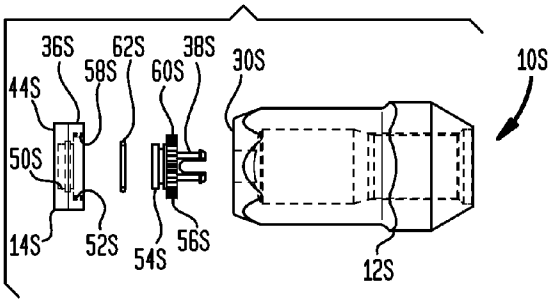



FIG. 90

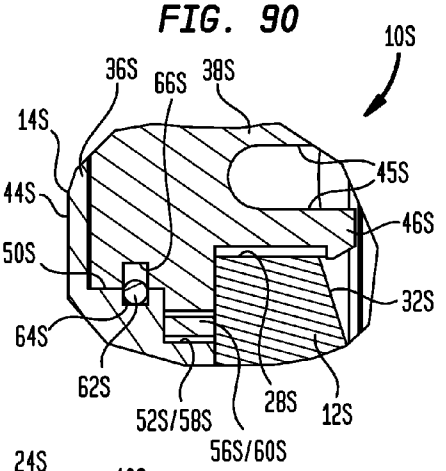



FIG. 91

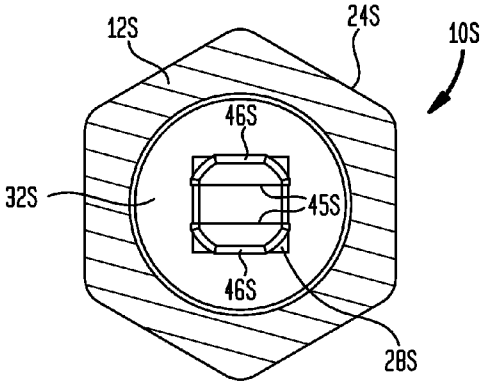


FIG. 92

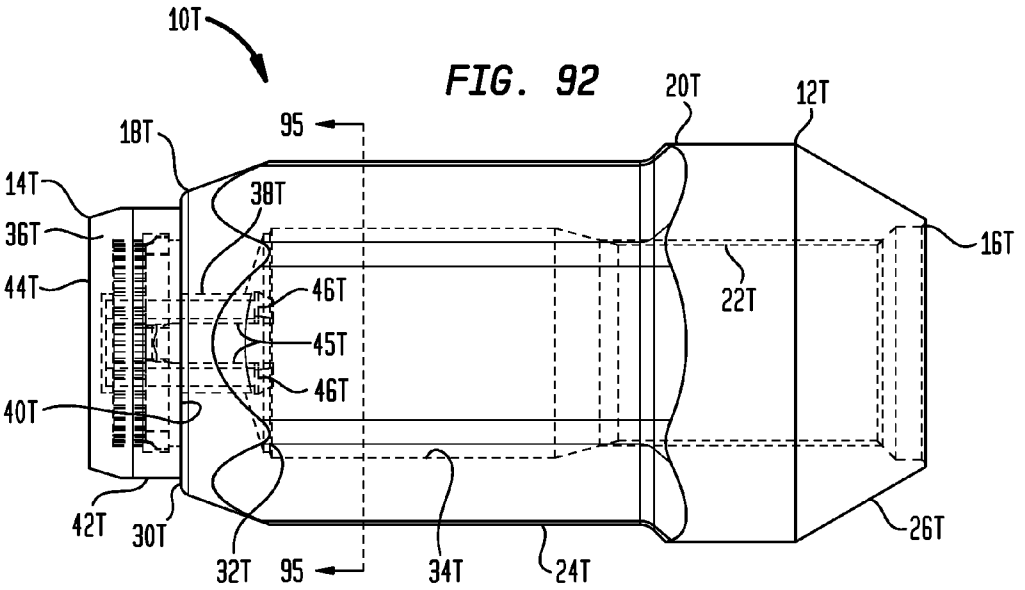



FIG. 93

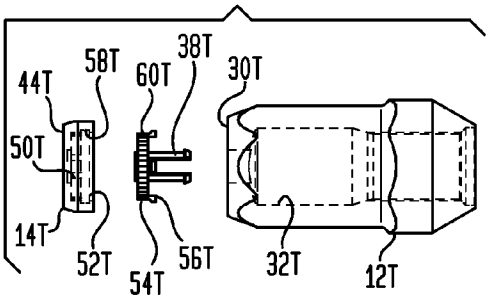



FIG. 94

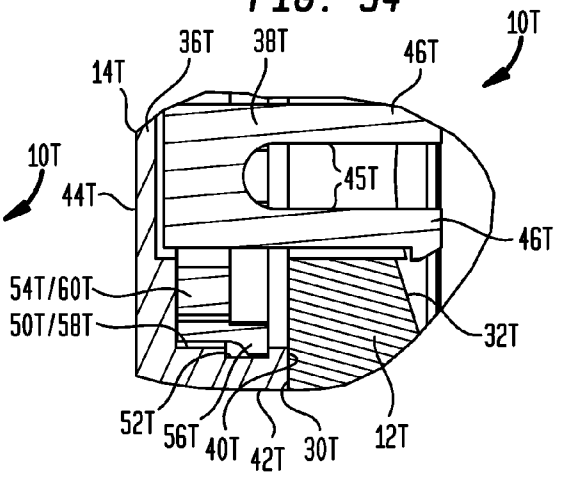
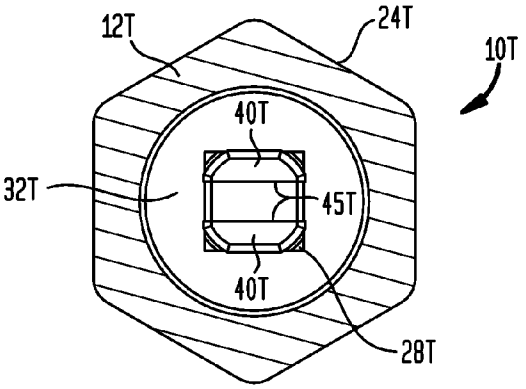



FIG. 95



# FASTENER WITH DISCRETE HEAD CAP

## CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This application claims priority to and the benefit under 35 U.S.C. 119(e) of U.S. Provisional Application No. 61/525,861 filed on Aug. 22, 2011. The entire contents of said Provisional Application No. 61/525,861 are hereby incorporated by this reference as if fully set forth herein.

## BACKGROUND

**[0002]** 1. Field

**[0003]** The present disclosure relates to threaded fasteners, such as nuts, bolts and security locks, for securing automotive vehicle wheels, and for other applications.

**[0004]** 2. Description of the Prior Art

**[0005]** By way of background, conventional threaded fasteners are typically configured with a threaded fastening portion and a patterned tool receiving portion. The fastening portion is adapted to engage a threaded stud or bore and bear against a structure to be secured. The tool receiving portion is adapted to receive a wrench or a key that engages and rotates the fastener. When such fasteners are installed, the end of the tool receiving portion is typically exposed to view, and depending on its configuration, may impart a decorative appearance to the installation. It is to improvements in threaded fastener design, and particularly the enhancement of fastener decorative characteristics, that the present disclosure is directed.

## SUMMARY

**[0006]** A threaded fastener comprises a fastener body having a first end, a second end and an intermediate portion extending between the first and second ends. A threaded portion is proximate to the first end. A tool engaging surface is provided on the intermediate portion. A discrete head cap is mounted in a head cap receiving bore that is provided at the second end. A head cap bearing surface surrounds an outside end of the head cap receiving bore. A head cap retaining surface is provided on the head cap receiving bore. The head cap has a rigid base and a central stem extending from the base. The head cap stem is disposed in the head cap receiving bore. The head cap base has a body bearing surface at a base of the stem that is in contacting or near-contacting engagement with the head cap bearing surface. The head cap base further has a head cap outer surface. A head cap retainer interconnects the head cap stem and the head cap retaining surface. The head cap retainer comprises a material of sufficient strength and rigidity to retain the head cap on the fastener body in a high-strength, axially non-deformable interconnection that holds the head cap in a substantially fixed and immovable axial position.

**[0007]** In an embodiment, the fastener is a nut and the threaded portion comprises a threaded bore. In another embodiment, the fastener is a bolt and the threaded portion comprises a threaded shank.

**[0008]** In an embodiment, the head cap outer surface may comprise a display surface bearing visual information content whose appearance is dependent on its rotational orientation, and the head cap may rotatable independently of the fastener body to orient the visual information content in a desired orientation when the fastener is installed at an arbitrary rotational position.

**[0009]** In an embodiment, a frictional interface can be maintained between the fastener head cap and the fastener body to prevent the fastener head cap from free-spinning on the fastener body while allowing the fastener head cap to be rotated by hand or by using a tool. The frictional interface may be provided by natural interfacial friction between contacting surfaces of the head cap and the fastener body. Alternatively, the frictional interface may be provided by a friction-enhancing material disposed between one or more opposing surfaces of the head cap and said fastener body. The friction-enhancing material may be selected from the group consisting of compressible and non-compressible materials, and may be an article selected from the group consisting of O-rings, gaskets and ring inserts. One location where the friction-enhancing material may be disposed is between the head cap bearing surface of the fastener body and the body bearing surface of the fastener head cap.

**[0010]** In an embodiment, the head cap bearing surface of the fastener body and the body bearing surface of the fastener head cap may comprise opposing substantially planar annular surfaces. The head cap retaining surface of the fastener body may comprise one of (1) an annular shoulder in the head cap receiving bore, (2) a thread pattern in the head cap receiving bore, (3) a groove in the head cap receiving bore, or (4) a staked ledge in the head cap receiving bore. Other retaining surface configurations could also be used.

**[0011]** In an embodiment, the head cap base may comprise a peripheral edge disposed inside a peripheral edge of the second end of the fastener body. The head cap base peripheral edge may be substantially circular, or may have other shapes. The head cap base outer surface may be substantially planar, or may have other shapes.

**[0012]** In an embodiment, the head cap retainer may comprise one of (1) a split ring retainer captured in a channel of the head cap stem, (2) a self-locking retention clip captured in a channel of the head cap stem, (3) one or more snap retainer arms integrally formed on the head cap stem, (4), one or more staked retainer arms integrally formed on the head cap stem, or (5) knurling integrally formed on the head cap stem. Other retention configurations could also be used.

**[0013]** In an embodiment, the tool engaging surface may comprise a configuration selected from the group consisting of square patterns, hexagonal patterns, spline patterns and external lock patterns. Other configurations could also be used.

**[0014]** In another aspect, a fastener comprises a fastener body and a decorative head cap rotatably mounted on the body. The decorative head cap bears visual information content whose appearance is dependent on its rotational orientation. The decorative head cap is rotatably positionable when the fastener is installed at an arbitrary rotational position in order to orient the visual information content in a desired orientation.

**[0015]** In another aspect, a fastener comprises a metal fastener body and a metal head cap mounted on the body using a metal head cap retainer. The head cap and/or the head cap retainer could also be plastic.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0016]** The foregoing and other features and advantages will be apparent from the following more particular description of example embodiments, as illustrated in the accompanying Drawings, in which:

**[0017]** FIG. **1** is a side elevation view showing an example fastener installation in which several threaded fasteners are used to secure a motor vehicle wheel;

**[0018]** FIG. **2** is an enlarged side elevation view showing one of the fasteners of FIG. **1** with a discrete fastener end cap that is plain and unadorned;

**[0019]** FIG. **3** is an enlarged side elevation view showing one of the fasteners of FIG. **1** with a discrete fastener end cap that carries text or graphics information content;

**[0020]** FIG. **4** is a side elevation view showing a threaded fastener according to a first example embodiment;

**[0021]** FIG. **5** is an exploded side elevation view showing the fastener of FIG. **4**;

**[0022]** FIG. **6** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **4**;

**[0023]** FIG. **7** is a cross-sectional view taken along line **7-7** in FIG. **4**;

**[0024]** FIG. **8** is a side elevation view showing a threaded fastener according to a second example embodiment;

**[0025]** FIG. **9** is an exploded side elevation view showing the fastener of FIG. **8**;

**[0026]** FIG. **10** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **8**;

**[0027]** FIG. **11** is a cross-sectional view taken along line **11-11** in FIG. **8**;

**[0028]** FIG. **12** is a side elevation view showing a threaded fastener according to a third example embodiment;

**[0029]** FIG. **13** is an exploded side elevation view showing the fastener of FIG. **12**;

**[0030]** FIG. **14** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **12**;

**[0031]** FIG. **15** is a cross-sectional view taken along line **15-15** in FIG. **12**;

**[0032]** FIG. **16** is a side elevation view showing a threaded fastener according to a fourth example embodiment;

**[0033]** FIG. **17** is an exploded side elevation view showing the fastener of FIG. **16**;

**[0034]** FIG. **18** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **16**;

**[0035]** FIG. **19** is a cross-sectional view taken along line **19-19** in FIG. **16**;

**[0036]** FIG. **20** is a side elevation view showing a threaded fastener according to a fifth example embodiment;

**[0037]** FIG. **21** is an exploded side elevation view showing the fastener of FIG. **20**;

**[0038]** FIG. **22** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **20**;

**[0039]** FIG. **23** is a cross-sectional view taken along line **23-23** in FIG. **20**;

**[0040]** FIG. **24** is a side elevation view showing a threaded fastener according to a sixth example embodiment;

**[0041]** FIG. **25** is an exploded side elevation view showing the fastener of FIG. **24**;

**[0042]** FIG. **26** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **24**;

**[0043]** FIG. **27** is a cross-sectional view taken along line **27-27** in FIG. **24**;

**[0044]** FIG. **28** is a side elevation view showing a threaded fastener according to a seventh example embodiment;

**[0045]** FIG. **29** is an exploded side elevation view showing the fastener of FIG. **28**;

**[0046]** FIG. **30** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **28**;

**[0047]** FIG. **31** is a cross-sectional view taken along line **31-31** in FIG. **28**;

**[0048]** FIG. **32** is a side elevation view showing a threaded fastener according to an eighth example embodiment;

**[0049]** FIG. **33** is an exploded side elevation view showing the fastener of FIG. **32**;

**[0050]** FIG. **34** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **32**;

**[0051]** FIG. **35** is a cross-sectional view taken along line **35-35** in FIG. **32**;

**[0052]** FIG. **36** is a side elevation view showing a threaded fastener according to a ninth example embodiment;

**[0053]** FIG. **37** is an exploded side elevation view showing the fastener of FIG. **36**;

**[0054]** FIG. **38** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **36**;

**[0055]** FIG. **39** is a cross-sectional view taken along line **39-39** in FIG. **36**;

**[0056]** FIG. **40** is a side elevation view showing a threaded fastener according to a tenth example embodiment;

**[0057]** FIG. **41** is an exploded side elevation view showing the fastener of FIG. **40**;

**[0058]** FIG. **42** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **40**;

**[0059]** FIG. **43** is a cross-sectional view taken along line **43-43** in FIG. **40**;

**[0060]** FIG. **44** is a side elevation view showing a threaded fastener according to an eleventh example embodiment;

**[0061]** FIG. **45** is an exploded side elevation view showing the fastener of FIG. **44**;

**[0062]** FIG. **46** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **44**;

**[0063]** FIG. **47** is a cross-sectional view taken along line **47-47** in FIG. **44**;

**[0064]** FIG. **48** is a side elevation view showing a threaded fastener according to a twelfth example embodiment;

**[0065]** FIG. **49** is an exploded side elevation view showing the fastener of FIG. **48**;

**[0066]** FIG. **50** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **48**;

**[0067]** FIG. **51** is a cross-sectional view taken along line **51-51** in FIG. **48**;

**[0068]** FIG. **52** is a side elevation view showing a threaded fastener according to a thirteenth example embodiment;

**[0069]** FIG. **53** is an exploded side elevation view showing the fastener of FIG. **52**;

**[0070]** FIG. **54** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **52**;

**[0071]** FIG. **55** is a cross-sectional view taken along line **55-55** in FIG. **52**;

**[0072]** FIG. **56** is a side elevation view showing a threaded fastener according to a fourteenth example embodiment;
**[0073]** FIG. **57** is an exploded side elevation view showing the fastener of FIG. **56**;
**[0074]** FIG. **58** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **56**;
**[0075]** FIG. **59** is a cross-sectional view taken along line **59-59** in FIG. **56**;
**[0076]** FIG. **60** is a side elevation view showing a threaded fastener according to a fifteenth example embodiment;
**[0077]** FIG. **61** is an exploded side elevation view showing the fastener of FIG. **60**;
**[0078]** FIG. **62** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **60**;
**[0079]** FIG. **63** is a cross-sectional view taken along line **63-63** in FIG. **60**;
**[0080]** FIG. **64** is a side elevation view showing a threaded fastener according to a sixteenth example embodiment;
**[0081]** FIG. **65** is an exploded side elevation view showing the fastener of FIG. **64**;
**[0082]** FIG. **66** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **64**;
**[0083]** FIG. **67** is a cross-sectional view taken along line **67-67** in FIG. **64**;
**[0084]** FIG. **68** is a perspective view showing a head cap used in the fastener of FIG. **64**;
**[0085]** FIG. **69** is a side elevation view of the head cap of FIG. **68**;
**[0086]** FIG. **70** is an end view of the head cap of FIG. **68**;
**[0087]** FIG. **71** is a perspective view of a friction-enhancing member used in the fastener of FIG. **64**;
**[0088]** FIG. **72** is a side elevation view of the friction-enhancing member of FIG. **71**;
**[0089]** FIG. **73** is an end view of the friction-enhancing member of FIG. **71**;
**[0090]** FIG. **74** is a perspective view showing a body portion of the fastener of FIG. **64**;
**[0091]** FIG. **75** is a side elevation view showing a threaded fastener according to a seventeenth example embodiment;
**[0092]** FIG. **76** is an exploded side elevation view showing the fastener of FIG. **75**;
**[0093]** FIG. **77** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **75**;
**[0094]** FIG. **78** is a perspective view showing a head cap used in the fastener of FIG. **75**;
**[0095]** FIG. **79** is a side elevation view of the head cap of FIG. **78**;
**[0096]** FIG. **80** is an end view of the head cap of FIG. **78**;
**[0097]** FIG. **81** is a side elevation view showing a threaded fastener according to an eighteenth example embodiment;
**[0098]** FIG. **82** is an exploded side elevation view showing the fastener of FIG. **81**;
**[0099]** FIG. **83** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **81**;
**[0100]** FIG. **84** is a perspective view showing a head cap used in the fastener of FIG. **81**;
**[0101]** FIG. **85** is a side elevation view of the head cap of FIG. **84**;
**[0102]** FIG. **86** is an end view of the head cap of FIG. **84**;
**[0103]** FIG. **87** is a perspective view showing a body portion of the fastener of FIG. **81**;
**[0104]** FIG. **88** is a side elevation view showing a threaded fastener according to a nineteenth example embodiment;
**[0105]** FIG. **89** is an exploded side elevation view showing the fastener of FIG. **88**;
**[0106]** FIG. **90** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **88**;
**[0107]** FIG. **91** is a cross-sectional view taken along line **91-91** in FIG. **88**;
**[0108]** FIG. **92** is a side elevation view showing a threaded fastener according to a twentieth example embodiment;
**[0109]** FIG. **93** is an exploded side elevation view showing the fastener of FIG. **92**;
**[0110]** FIG. **94** is an enlarged fragmented cross-sectional view showing a head cap retaining arrangement used on the fastener of FIG. **92**; and
**[0111]** FIG. **95** is a cross-sectional view taken along line **95-95** in FIG. **92**.

## DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

### Introduction

**[0112]** Turning now to the drawings, which are not necessarily to scale, various alternate embodiments of a fastener with a discrete head cap will now be described. FIG. **1** illustrates an example fastener installation in which an automotive vehicle wheel **2** is shown comprising a tire **4** mounted on a rim **6**. The rim **6** is secured to an axle **8** by a plurality of fasteners **10**. As shown in FIGS. **2** and **3**, each fastener **10** has a fastener body **12** and a discrete head cap **14**. As shown in FIG. **2**, the head cap **14** may be plain and unadorned, without decoration or other visual information content. Alternatively, as shown in FIG. **3**, the head cap **14** may be decorative and used to display text, a logo or other visual information content. In some embodiments, the head cap **14** may be fixedly retained on the fastener body **12** so as to be non-rotatable. This form of attachment is suited for plain and unadorned head caps **14**, as well as for head caps comprising visual information content but wherein the content is not sensitive to rotation. In other embodiments, particularly those in which the head cap **14** displays positionally sensitive information, the head cap may be mounted so as to be rotatable independently of the fastener body **12** in order to orient the visual information content in the desired orientation when the fastener **10** is installed at an arbitrary rotational position. By allowing the head cap **14** to rotate, the information content thereon can be displayed in a desired orientation regardless of the final rotational position of fastener **10** when it is installed at its design installation torque.

### Summary of Disclosed Embodiments

**[0113]** Twenty example embodiments of the fastener **10** are shown in the accompanying drawings and described in more detail below. Embodiments 1-14 and 16-20 depict vehicle lug nuts while Embodiment 15 depicts a vehicle lug bolt. As stated above, fasteners for other end-use applications may also be constructed in accordance with the present disclosure. Except as otherwise indicated below, all components of the illustrated fastener embodiments are made from a suitable metal, such as steel, stainless steel, titanium, brass, alumi-

num, etc., or in the case of head cap itself, from a suitable metal or plastic material. Some or all of the fastener components may be surface treated with additional materials, such as a dip- or spray-coating, electro-plating, etc. Various head cap retainer devices may be used to permanently retain the head cap on the fastener body so that the head cap cannot be removed once the fastener has been installed. Alternatively, the head caps may be removably mounted. Each head cap retainer device can be made from metal, rigid plastic or other material of suitable strength and rigidity, and is designed to provide a high-strength, axially non-deformable interconnection that holds the head cap in a substantially fixed and immovable axial position such that the head cap bearing surface of the fastener body and the body bearing surface of the head cap base will remain in the desired contacting or nearly-contacting relationship when the head cap is not being rotated.

Embodiment 1

**[0114]** Turning now to FIGS. **4-7**, a first example fastener embodiment **10**A, representing a nut-type fastener, is shown. The fastener **10**A comprises a fastener body **12**A and a discrete head cap **14**A. The fastener body **12**A includes a first end **16**A (the fastening end), a second end **18**A (the head end) and an intermediate portion **20**A extending between the fastening end and the head end. A threaded portion **22**A of the fastener body **12**A has a starting point disposed proximate to the fastening end **16**A and an ending point spaced a selected distance from the thread starting point along the length of the fastener body **12**A. Because this embodiment is a nut, the threaded portion **22**A is formed as a threaded bore. The threaded portion **22**A extends nearly half the length of the fastener body **12**A, and may be formed as a machined through-bore with a designed bore profile comprising sections of different diameter.

**[0115]** A tool engaging surface **24**A of the fastener body **12**A has a starting point disposed proximate to the head end **18**A and an ending point spaced a selected distance from the tool engaging surface starting point along the length of the fastener body **12**A. By way of example, the tool engaging surface **24**A may extend over a substantial portion of the fastener body **12**A. The tool engaging surface **24**A comprises a hexagonal pattern, but could have any other desired configuration, including a square pattern, a spline pattern, an external lock pattern, etc.

**[0116]** A fastener seat portion **26**A is provided proximate to the fastening end **16**A. The fastener seat portion **26**A is shown as being tapered, but could also be rounded. A head head cap receiving bore **28**A is disposed at the head end **18**A in order to mount the fastener head cap **14**A. A head cap bearing surface **30**A radially surrounds an outside end of the head cap receiving bore **28**A. A head cap retaining shoulder **32**A radially surrounds an inside end of the head cap receiving bore **28**A in order to provide a head cap retaining surface for retaining the head cap **14**A. The head cap retaining shoulder **32**A is formed by a flange extending radially outwardly from the inside end of the head cap receiving bore to a larger head cap receiving bore extension **34**A formed within the fastener body **12**A. In the illustrated embodiment, the bore extension **34**A is part of a main bore that extends through the fastener body **12**A. The bore extension **34**A could also be formed as a blind bore if the fastener **10**A did not have such a main bore. The head cap retaining shoulder **32**A comprises a substantially planar, continuous annular surface. In other embodiments, the retaining shoulder might **32**A be discontinuous and/or non-annular and/or non-planar.

**[0117]** The head cap **14**A is mounted at the head end **18**A. The head cap **14**A has a structurally rigid base **36**A and a structurally rigid central stem **38**A extending from the base. The head cap stem **38**A, which may be solid or hollow, is journaled or otherwise carried in the head cap receiving bore **28**A. The head cap stem **38**A may be cylindrical if rotation of the head cap **14**A is desired, or it could be non-cylindrical if head cap rotation is not required. The head cap receiving bore **28**A has a corresponding shape and size that substantially matches the configuration of the head cap stem **38**A.

**[0118]** The head cap base **36**A has an inner body bearing surface **40**A that is in facing relationship with the fastener body's head cap bearing surface **30**A. In the illustrated embodiment, the head cap bearing surface **30**A of the fastener body **12**A and the body bearing surface **40**A of the head cap base **36**A comprise opposing substantially planar annular surfaces that are either touching or nearly touching so that a pry tool may not be introduced between these surfaces. Non-planar surface configurations (e.g., tapered, radiused, etc.) could also be used.

**[0119]** The head cap base **36**A may be sized so that its peripheral edge **42**A is disposed inside a peripheral edge of the head end **18**A. It could also wrap around the peripheral edge of the head end **18**A. The head cap peripheral edge **42**A may be substantially circular in shape or of any other desired configuration (e.g., polygonal, oval, patterned, etc.). The head cap base **36**A further has an outer face surface **44**A that may be substantially planar or of non-planar surface configuration. The head cap outer surface **44**A may be plain and unadorned, as shown in FIG. **2**, or it may display visual information content, as shown in FIG. **3**. The visual information content may be formed on the head cap outer surface **44**A in any suitable manner. Examples include information content that is applied as a separate coating or layer on the head cap outer surface **44**A and information content that is formed on or in the head cap outer surface, such as by molding, engraving, etching, etc. The information content could also be provided using a combination of techniques. Examples of visual information content that may be provided on the head cap outer surface include a graphic design, a logo, text, one or more colors, combinations of the foregoing, or any other form of display that is visible to the human eye. In some cases, the visual information content may have a defined orientation direction that is preferred relative to other orientations. Text is one example. A logo (e.g., a mark, name, symbol or device) would be another example. Other types of visual information content might not have a defined orientation direction, but will nonetheless be sensitive to the rotational position of the fastener head cap because such rotation will produce a change in appearance. Examples include asymmetrical designs and symmetrical designs whose appearance varies with rotation.

**[0120]** The head cap **14**A is retained on the fastener body **12**A using a head cap retainer **46**A. In the illustrated embodiment, the head cap retainer **46**A comprises a metal split ring retainer that is captured in a channel **48**A formed in the head cap stem **38**A. The head cap retainer **46**A retains the head cap **14**A on the fastener body **12**A by engaging the head cap retaining shoulder **32**A. It may be radially compressed to facilitate installation of the head cap **14**A into the head cap receiving bore **28**A, but will expand back to its nominal size in order to lock the head cap in place once the head cap

retaining shoulder **32**A is cleared. The head cap **14**A is preferably made from metal so that the associated head cap retainer **46**A will possess the requisite retention strength and rigidity that provides a high-strength, axially non-deformable interconnection that holds the head cap in a substantially fixed and immovable axial position. Alternatively, the head cap **14**A may comprise a non-metallic material, such as rigid, high strength plastic.

**[0121]** It will be appreciated that the head cap **14**A is mounted for rotation relative to the fastener body **12**A in the illustrated embodiment. As such, it may be desired that the head cap **14**A does not freely spin on the fastener body **12**A, but has some resistance to rotation so that its rotational position remains stable unless and until the head cap is intentionally rotated to adjust its position. The torque required to rotate the head cap may be controlled by the selecting the retaining force applied by the head cap retainer **46**A and by providing a suitable frictional interface between one or more opposing surfaces of the head cap **14**A and the fastener body **12**A. The frictional interface prevents the head cap **14**A from free-spinning on the fastener body **12**A while allowing the head cap to be rotated by hand or by using a tool.

**[0122]** The frictional interface may be provided by a friction-enhancing material disposed between one or more opposing surfaces of the head cap **14**A and the fastener body **12**A. Such a friction-enhancing material may be selected from the group consisting of compressible and non-compressible materials. In the illustrated embodiment, the friction-enhancing material is provided by a friction-enhancing article selected from the group consisting of O-rings, gaskets and inserts. In particular, a rubber O-ring **50**A is installed at the junction of the head cap base **36**A and the head cap stem **38**A. A chamfer **52**A may be formed at the entrance to the head cap receiving bore **28**A to accommodate the O-ring **50**A. This will allow the head cap bearing surface **30**A of the fastener body **12**A to engage, or nearly engage, the body bearing surface **40**A of the head cap base **36**A.

Embodiment 2

**[0123]** Turning now to FIGS. **8-11**, a second example fastener embodiment **10**B is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**B that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "B." The fastener **10**B differs from the fastener **10**A in that the head cap retainer **46**B is a metal self-locking retention clip with outwardly radiating tabs. The head cap retainer **46**B is captured in the channel **48**B of the head cap stem **38**B, and the retention clip's outwardly radiating tabs retain the head cap **14**B by engaging the head cap retaining shoulder **32**B on the fastener body **12**B.

Embodiment 3

**[0124]** Turning now to FIGS. **12-15**, a third example fastener embodiment **10**C is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**C that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "C." The fastener **10**C differs from the fastener **10**A in that the head cap retainer **46**C comprises one or more snap retainer arms integrally formed on the head cap stem **38**C (which is hollow).

**[0125]** The snap retainer arms engage the head cap retaining shoulder **32**C on the fastener body **12**C.

Embodiment 4

**[0126]** Turning now to FIGS. **16-19**, a fourth example fastener embodiment **10**D is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**D that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "D." The fastener **10**D differs from the fastener **10**A in that the head cap retainer **46**D comprises one or more staked retainer arms integrally formed on the head cap stem **38**D (which is hollow). The staked retainer arms engage the head cap retaining shoulder **32**D on the fastener body **12**D. The retainer arms may be staked after the head cap **14**D is seated on the fastener body **12**D by accessing the head cap receiving bore **28**D from the fastening end **16**D.

Embodiment 5

**[0127]** Turning now to FIGS. **20-23**, a fifth example fastener embodiment **10**E is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**E that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "E." The fastener **10**E differs from the fastener **10**A in that the head cap retainer **46**E comprises knurling integrally formed on the head cap stem **38**E. The knurling engages the head cap retaining shoulder **32**E on the fastener body **12**E.

Embodiment 6

**[0128]** Turning now to FIGS. **24-27**, a sixth example fastener embodiment **10**F is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**F that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "F." The fastener **10**F differs from the fastener **10**A in that the head cap retainer O-ring **50**A is replaced with a friction-enhancing compressible gasket **50**F. The gasket **50**F, which can be made from rubber, plastic, or other compressible material, seats in an annular well **52**F that is formed in the head cap bearing surface **30**F.

Embodiment 7

**[0129]** Turning now to FIGS. **28-31**, a seventh example fastener embodiment **10**G is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**G that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "G." The fastener **10**G differs from the fastener **10**A in that the head cap retainer O-ring **50**A is replaced with a compressible or incompressible plastic insert **50**G. The friction-enhancing insert **50**G has a rectangular cross-section and seats in an annular well **52**G that is formed in the head cap bearing surface **30**G. The body bearing surface **40**G of the head cap base **36**G and the opposing surface of the friction-enhancing insert **50**G may be respectively provided with a friction-enhancing surface treatment **54**G and **56**G, such as knurling, or some other geometry that provides resistance against rotation.

Embodiment 8

**[0130]** Turning now to FIGS. **32-35**, an eighth example fastener embodiment **10**H is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**H that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "H." The fastener **10**H differs from the fastener **10**A in that the head cap retainer O-ring **50**A is eliminated entirely. This embodiment uses natural interfacial friction between the body bearing surface **40**H of the head cap base **36**H and the opposing head cap bearing surface **30**H of the fastener body **12**H to resist rotation.

Embodiment 9

**[0131]** Turning now to FIGS. **36-39**, a ninth example fastener embodiment **10**I is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**I that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "I." The fastener **10**I differs from the fastener **10**A in that the tool engaging portion **241** is configured with a spline pattern comprising longitudinal grooves.

Embodiment 10

**[0132]** Turning now to FIGS. **40-43**, a tenth example fastener embodiment **10**J is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**J that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "J." The fastener **10**J differs from the fastener **10**A in that the tool engaging portion **24**J is quite short, and is configured with an external lock pattern configuration comprising a non-uniform distribution of key receiving lock pattern grooves. This embodiment also features a break-away post **21**J (for security enhancement) whose terminal end provides the head end **18**J of the fastener body **12**J.

Embodiment 11

**[0133]** Turning now to FIGS. **44-47**, an eleventh example fastener embodiment **10**K is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**K that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "K." The fastener **10**K differs from the fastener **10**A in that there is no head cap retaining shoulder at the inside end of the head cap receiving bore **28**K. Instead, the head cap receiving bore **28**K is provided by the main through-bore **34**K of the fastener body **12**K. In lieu of having a head cap retaining shoulder, a thread pattern **35**K on the main through-bore **34**K is used to provide a head cap retaining surface that is engaged by the head cap retainer **46**K to retain the head cap **14**K. The threaded portion extends nearly the entire length of the fastener body **12**K. This configuration would be most commonly used when the fastener **10**K is a lug nut that is made using a cold forming technique from a fastener blank having a formed single-diameter through-hole. The head cap retainer **46**K is implemented as a metal self-locking retention clip with outwardly radiating tabs.

Embodiment 12

**[0134]** Turning now to FIGS. **48-51**, a twelfth example fastener embodiment **10**L is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**L that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "L." The fastener **10**K differs from the fastener **10**A in that the tool engaging portion **24**L is quite short, and is configured with an external lock pattern configuration comprising a non-uniform distribution of key receiving lock pattern grooves. This embodiment also features a break-away post **21**L (for security enhancement) whose terminal end provides the head end **18**L of the fastener body **12**L. The fastener **10**L also differs from the fastener **10**A in that there is no head cap retaining shoulder at the inside end of the head cap receiving bore **28**L. Instead, the head cap receiving bore **28**L is provided by the main through-bore **34**L of the fastener body **12**L. In lieu of having a head cap retaining shoulder, a thread pattern **35**L on the main through-bore **34**L is used to provide a head cap retaining surface that is engaged by the head cap retainer **46**L to retain the head cap **14**L. The head cap retainer **46**L is implemented as a metal split ring retainer.

Embodiment 13

**[0135]** Turning now to FIGS. **52-55**, a thirteenth example fastener embodiment **10**M is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**M that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "M." The fastener **10**M differs from the fastener **10**A in that the tool engaging portion **24**M is configured with a spline pattern comprising longitudinal grooves. The fastener **10**M also differs from the fastener **10**A in that there is no head cap retaining shoulder at the inside end of the head cap receiving bore **28**M. Instead, the head cap receiving bore **28**M is provided by the main through-bore **34**M of the fastener body **12**M. In lieu of having a head cap retaining shoulder, a thread pattern **35**M on the main through-bore **34**M is used to provide a head cap retaining surface that is engaged by the head cap retainer **46**M to retain the head cap **14**M. The head cap retainer **46**M is implemented as a metal split ring retainer.

Embodiment 14

**[0136]** Turning now to FIGS. **56-59**, a fourteenth example fastener embodiment **10**N is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**N that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "N." The fastener **10**N differs from the fastener **10**A in that there is no head cap retaining shoulder at the inside end of the head cap receiving bore **28**N. Instead, the head cap receiving bore **28**N is provided by the main through-bore **34**N of the fastener body **12**N. In lieu of having a head cap retaining shoulder, a groove **35**N is formed in the main through-bore **34**N to provide a head cap retaining ledge that is engaged by the head cap retainer **46**N to retain the head cap **14**N. The groove **35**N may be formed using a secondary machining operation. Alternatively, a ring-retaining ledge could be formed using a staking operation. The head cap retainer **46**N is implemented as a

metal self-locking retention clip with outwardly radiating tabs. A split-ring retainer could also be used.

Embodiment 15

**[0137]** Turning now to FIGS. **60-63**, a fifteenth example fastener embodiment **10**O is shown. This embodiment depicts a bolt-type fastener, such that the threaded portion **22**O is a threaded shank rather than a threaded bore. Structures of the fastener **10**O that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "O." Apart from being a bolt, the fastener **10**O differs from the fastener **10**A in that the tool engaging portion **24**O is quite short, and is configured with an external lock pattern configuration comprising a non-uniform distribution of key receiving lock pattern grooves. This embodiment also features a break-away post **21**O (for security enhancement) whose terminal end provides the head end **18**O of the fastener body **12**O. The head cap receiving bore extension **34**O is also formed as a blind bore formed at the head end **18**O of the fastener body **12**O.

Embodiment 16

**[0138]** Turning now to FIGS. **64-74**, a sixteenth example fastener embodiment **10**P is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**P that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "P." The fastener **10**P differs from the fastener **10**A in that a different type of frictional interface is provided between opposing surfaces of the head cap **14**P and the fastener body **12**P. This alternative frictional interface allows the head cap **14**P to be incrementally rotated in a controlled manner through a predefined set of positions relative to the fastener body **12**P. In particular, a pair of opposing detent inserts **50**P are respectively mounted on the fastener body **12**P and the head cap **14**P. An annular recess **52**P formed in the head cap bearing surface **30**P of the fastener body **12**P mounts one of the detent inserts **50**P. An annular recess **54**P formed in the body bearing surface **40**P of the head cap base **36**P mounts the other detent insert **50**P. As best shown in FIGS. **71-73**, the opposing surfaces of the detent inserts **50**P are formed with radially oriented, inter-engaging ratchet teeth **56**P. The detent inserts **50**P also have keyed bores **58**P that are respectively inter-engage corresponding detent portions **60**P of the head cap bearing surface **30**P and the body bearing surface **40**P. This inter-engagement fixes the detent inserts **50**P against rotation relative to the head cap and fastener body structures on which they are respectively mounted.

**[0139]** The fastener **10**P also differs from the fastener **10**A in that a spring washer **47**P is placed between the head cap retainer **46**P and the head cap retaining shoulder **32**P. The spring washer **47**P provides a flexible interconnection between the head cap **14**P and the fastener body **12**P that enables these components to be longitudinally displaced relative to each other. Normally, the head cap **14**P will not rotate relative to the fastener body **12**P due to the force of the spring washer **47**P holding the opposing detent inserts **50**P in interlocking engagement. If it is desired to rotate the head cap **14**P, a rotating force can be applied thereto. As this occurs, the tapered sides of the opposing ratchet teeth **56**P will ride up against each other, acting as cam members to cause the detent inserts **50**P to separate from each other against the compressive force of the spring washer **47**P until the opposing ratchet teeth **56**P shift rotationally and re-engage each other with the head cap **14**P in a new rotational position. To assist in rotating the head cap **14**P, the sides of the head cap base **36**P may be provided with a pair of tool-engaging or finger-engaging surfaces **62**P that may be gripped with an appropriate gripping tool, such as a pair of pliers, or with the fingers. With the foregoing arrangement, it will be appreciated that rotation between the head cap **14**P and the fastener body **12**P will occur in a controlled manner, with each incremental rotational position of the head cap being defined by the discrete inter-engagement positions of the ratchet teeth **56**P. The head cap rotation may be bi-directional or uni-directional.

Embodiment 17

**[0140]** Turning now to FIGS. **75-80** a seventeenth example fastener embodiment **10**Q is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**Q that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "Q." The fastener **10**Q represents a modification of the above-described fastener **10**P in which there is only a single detent insert **50**Q that is mounted in an annular recess **52**Q formed in the head cap bearing surface **30**Q of the fastener body **12**Q. The same detent mounting arrangement used in the preceding embodiment to mount the detent insert **50**P to the fastener body **12**P may be used. The detent insert **50**Q has a set of radially oriented ratchet teeth **56**Q that inter-engage a corresponding set of radially oriented ratchet teeth **56**Q formed on the body bearing surface **40**Q of the head cap **14**Q.

**[0141]** The fastener **10**Q also differs from the fastener **10**P in that the head cap stem **38**Q is discontinuous and formed as a set of one or more flexible tabs or prongs **45**Q that each have an integrated retainer flange **46**Q at their free end to provide an integral head cap retainer. The retainer flanges **46**Q releasably engage the head cap retaining shoulder **32**Q in a manner that allows these components to be longitudinally displaced relative to each other. Normally, the head cap **14**Q will not rotate relative to the fastener body **12**Q because the engagement between the retainer flanges **46**Q and the head cap retaining shoulder **32**Q holds the opposing ratchet teeth **56**Q of the head cap **14**Q and the detent insert **50**Q in interlocking engagement. If it is desired to rotate the head cap **14**Q, a rotating force can be applied thereto. As this occurs, the tapered sides of the opposing ratchet teeth **56**Q will ride up against each other, acting as cam members to cause the head cap retaining shoulder **32**Q and the detent insert **50**Q to separate from each other. At the same time, the flexible prongs **45**Q are forced to flex inwardly to partially disengage the retainer flanges **46**Q to while providing a compressive force that opposes the aforementioned separation. The ability of the retainer flanges **46**Q to partially disengage from the head cap retaining shoulder **32**Q is due to the opposing surfaces of these components having tapered configurations. Once the opposing ratchet teeth **56**Q separate from each other, the teeth will shift rotationally and re-engage each other with the head cap **14**Q in a new rotational position. Again, the head cap **14**Q may be provided with a pair of tool-engaging or finger-engaging surfaces **62**Q that may be gripped with an appropriate gripping tool, such as a pair of pliers, or with the fingers. The head cap rotation may be bi-directional or uni-directional.

Embodiment 18

**[0142]** Turning now to FIGS. **81-87** an eighteenth example fastener embodiment **10**R is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**R that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "R." The fastener **10**R represents a modification of the above-described fasteners **10**P and **10**Q in that all detent inserts are eliminated. Instead, the head cap receiving bore **28**R and the head cap stem **38**R are respectively formed with longitudinally oriented, inter-engaging ratchet teeth **56**R and **58**R. The ratchet teeth **56**R on the head cap receiving bore **28**R extend around the bore circumference. The ratchet teeth **58**R on the head cap stem **38**R are formed on flexible tabs **60**R that extend from two of the prongs **45**R that comprise the head cap stem. Like the fastener **10**Q, the head cap stem **38**R is discontinuous and formed as a set of one or more flexible tabs or prongs **45**R that each have an integrated retainer flange **46**R at their free end to provide an integral head cap retainer. The retainer flanges **46**R releasably engage the head cap retaining shoulder **32**R in a manner that allows these components to be longitudinally displaced relative to each other.

**[0143]** Normally, the head cap **14**R will not rotate relative to the fastener body **12**R because the engagement between the retainer flanges **46**R and the head cap retaining shoulder **32**R holds the head cap stem **38**R in the head cap bore **28**R, with the ratchet teeth **56**R and **58**R in interlocking engagement. If it is desired to rotate the head cap **14**R, a rotating force can be applied thereto. As this occurs, the tapered sides of the opposing ratchet teeth **56**R and **58**R ride up against each other, acting as cam members to cause the tabs **60**R that carry the ratchet teeth **58**R to flex inwardly until the opposing teeth **56**R and **58**R shift rotationally and re-engage with the head cap **14**P in a new rotational position. Again, the head cap **14**R may be provided with a pair of tool-engaging or finger-engaging surfaces **62**R that may be gripped with an appropriate gripping tool, such as a pair of pliers, or with the fingers. The head cap rotation may be bi-directional or uni-directional.

Embodiment 19

**[0144]** Turning now to FIGS. **88-91**, a nineteenth example fastener embodiment **10**S is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**S that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "S." The fastener **10**P differs from the fastener **10**A in that the head cap **14**S is a two-piece assembly in which the head cap base **36**S is separate from the head cap stem **38**S. For reasons that will become apparent below, the head cap base **36**S is preferably made from a harder material than the head cap stem **38**S, or visa versa. For example, the head cap base **36**S could be made from metal and the head cap stem **38**S could be made from plastic. The head cap base **36**S is formed with inner and outer concentric bores **50**S and **52**S and the head cap stem **38**S is formed with inner and outer concentric posts **54**S and **56**S. The inner bore **50**S of the head cap base **36**S receives the inner post **54**S of the head cap stem **38**S, and is releasably secured thereto by way of a retention ring **62**S. As best shown in FIG. **90**, the retention ring **62**S is captured in opposing annular channels **64**S and **66**S that are respectively formed on the head cap base **36**S and the head cap stem **38**S. The retention ring **62**S prevents the head cap **14**S and the fastener body **12**S from being longitudinally displaced relative to each other. The outer bore **52**S of the head cap base **36**S receives the outer post **56**S of the head cap stem **38**S. Longitudinally oriented, inter-engaging ratchet teeth **58**S and **60**S are respectively formed on the walls of the outer bore **52**S and the outer post **56**S so that the head cap base **36**S can be incrementally rotated in a controlled manner through a predefined set of positions relative to the head cap stem **38**S.

**[0145]** The head cap stem **38**S of the fastener **10**S is discontinuous and formed as a pair of flexible tabs or prongs **45**S that each have an integrated retainer flange **46**S at their free end to provide an integral head cap retainer. The retainer flanges **46**S engage the head cap retaining shoulder **32**S. The head cap receiving bore **28**S is also square, which a provides a keyway that fixes the rotational position of the head cap stem **38**S relative to the fastener body **12**S. Other keyway shapes could also be used. Normally, the head cap **14**S will not rotate relative to the fastener body **12**S due to the inter-engagement between the ratchet teeth **58**S and **60**S on the head cap base **36**S and the head cap stem **38**S, respectively. If it is desired to rotate the head cap **14**S, a rotating can be applied thereto. As this occurs, the tapered sides of the opposing ratchet teeth **56**S and **58**S will ride up against each other, with the harder ratchet teeth **58**S on the head cap base **36**S acting as cam members to deform the softer ratchet teeth **56**S on the head cap stem **38**S until the teeth clear each other, shift rotationally, and re-engage with the head cap base in a new rotational position.

Embodiment 20

**[0146]** Turning now to FIGS. **92-95**, a twentieth example fastener embodiment **10**T is shown. This embodiment again depicts a nut-type fastener. Structures of the fastener **10**T that find correspondence in the previously-described fastener **10**A are indicated by corresponding reference numbers, but with the letter "A" replaced by the letter "T." The fastener **10**T represents a modification of the above-described fastener **10**S in that the head cap base **36**T and the head cap stem **38**T, though separate components, are of somewhat different construction. In particular, the head cap base **36**T is formed with a main bore **50**T having an annular channel **52**T, and the head cap stem **38**T is formed with a main post **54**T having a set of one or more tabs or prongs **56**T. As in the preceding embodiment, the head cap base **36**T is preferably made from a harder material than the head cap stem **38**T, or visa versa. For example, the head cap base **36**T could be made from metal and the head cap stem **38**T could be made from plastic. The main bore **50**T of the head cap base **36**T receives the main post **54**T of the head cap stem **38**T, and is secured thereto by way of the tabs or prongs **56**T being captured in the annular channel **52**T in a manner that prevents these components from being longitudinally displaced relative to each other. Longitudinally oriented, inter-engaging ratchet teeth **58**T and **60**T are respectively formed on the walls of the main bore **52**T and the main post **56**T so that the head cap base **36**T can be incrementally rotated in a controlled manner through a predefined set of positions relative to the head cap stem **38**T.

**[0147]** The head cap stem **38**T of the fastener **10**T is discontinuous and formed as a pair of flexible tabs or prongs **45**T that each have an integrated retainer flange **46**T at their free end to to provide an integral head cap retainer. The retainer flanges **46**T engage the head cap retaining shoulder **32**T. The head cap receiving bore **28**T is also square, which a provides

a keyway that fixes the rotational position of the head cap stem **38**T relative to the fastener body **12**T. Other keyway shapes could also be used. Normally, the head cap **14**T will not rotate relative to the fastener body **12**T due to the inter-engagement between the ratchet teeth **58**T and **60**T on the head cap base **36**T and the head cap stem **38**T, respectively. If it is desired to rotate the head cap **14**T, a rotating force can be applied thereto. As this occurs, the tapered sides of the opposing ratchet teeth **58**T and **60**T will ride up against each other, with the harder ratchet teeth **58**T on the head cap base **36**T acting as cam members to deform the softer ratchet teeth **56**T on the head cap stem **38**T until the teeth clear each other, shift rotationally, and re-engage with the head cap base in a new rotational position.

**[0148]** Accordingly, a number of security fasteners with discrete end caps have been disclosed. While various embodiments of the invention have been described, it should be apparent that many variations and alternative embodiments could be implemented in accordance with the invention. It is understood, therefore, that the invention is not to be in any way limited except in accordance with the spirit of the appended claims and their equivalents.

What is claimed is:

**1**. A fastener, comprising:

a fastener body having a first end, a second end and an intermediate portion extending between said first and second ends;

a threaded portion proximate to said first end;

a tool engaging surface on said intermediate portion;

a head cap receiving bore at said second end;

a discrete head cap bearing surface surrounding an outside end of said head cap receiving bore;

a head cap retaining surface on said head cap receiving bore;

a head cap having a rigid base and a central stem extending from said base;

said head cap stem being disposed in said head cap receiving bore;

said head cap base having a body bearing surface at a base of said stem in contacting or near-contacting engagement with said head cap bearing surface;

said head cap base further having a head cap outer surface; and

a head cap retainer interconnecting said central stem and said head cap retaining surface, said head cap retainer comprising a material of sufficient strength and rigidity to retain said head cap on said fastener body in a high-strength, axially non-deformable interconnection that holds said head cap in a substantially fixed and immovable axial position.

**2**. The fastener of claim **1**, wherein:

said head cap outer surface comprises a display surface bearing visual information content whose appearance is dependent on its rotational orientation; and

said head cap is rotatable independently of said fastener body to orient said visual information content in a desired orientation when said fastener is installed at an arbitrary rotational position.

**3**. The fastener of claim **1**, wherein said fastener is a nut and said threaded portion comprises a threaded bore.

**4**. The fastener of claim **1**, wherein said fastener is a bolt and said threaded portion comprises a threaded shank.

**5**. The fastener of claim **1**, wherein a frictional interface is maintained between said fastener head cap and said fastener body to prevent said fastener head cap from free-spinning on said fastener body while allowing said fastener head cap to be rotated by hand or by using a tool.

**6**. The fastener of claim **5**, wherein said frictional interface is provided by natural interfacial friction between contacting surfaces of said head cap and said fastener body.

**7**. The fastener of claim **5**, wherein said frictional interface is provided by a friction-enhancing material disposed between one or more opposing surfaces of said head cap and said fastener body.

**8**. The fastener of claim **7**, wherein said friction-enhancing material is selected from the group consisting of compressible and non-compressible materials.

**9**. The fastener of claim **7**, wherein said friction-enhancing material is provided by an article selected from the group consisting of O-rings, gaskets and ring inserts.

**10**. The fastener of claim **7**, wherein said friction-enhancing material is disposed between said head cap bearing surface of said fastener body and said body bearing surface of said fastener head cap.

**11**. The fastener of claim **1**, wherein said head cap bearing surface of said fastener body and said body bearing surface of said fastener head cap comprise opposing substantially planar annular surfaces.

**12**. The fastener of claim **1**, wherein said head cap retaining surface of said fastener body comprises one of (1) an annular shoulder in said head cap receiving bore, (2) a thread pattern in said head cap receiving bore, (3) a groove in said head cap receiving bore, or (4) a staked ledge in said head cap receiving bore.

**13**. The fastener of claim **1**, wherein said head cap base comprises a peripheral edge disposed inside a peripheral edge of said second end of said fastener body.

**14**. The fastener of claim **13**, wherein said head cap base peripheral edge is substantially circular in shape.

**15**. The fastener of claim **1**, wherein said head cap base outer surface is substantially planar.

**16**. The fastener of claim **1**, wherein said head cap retainer comprises a split ring retainer captured in a channel of said head cap stem.

**17**. The fastener of claim **1**, wherein said head cap retainer comprises a self-locking retention retention clip captured in a channel of said head cap stem.

**18**. The fastener of claim **1**, wherein said head cap retainer comprises one or more snap retainer arms integrally formed on said head cap stem.

**19**. The fastener of claim **1**, wherein said head cap retainer comprises one or more staked retainer arms integrally formed on said head cap stem.

**20**. The fastener of claim **1**, wherein said head cap retainer comprises knurling integrally formed on said head cap stem.

**21**. The fastener of claim **1**, wherein said tool engaging surface comprises a configuration selected from the group consisting of square patterns, hexagonal patterns, spline patterns and external lock patterns.

**22**. A fastener comprising a fastener body and a decorative head cap rotatably mounted on said body bearing visual information content whose appearance is dependent on its rotational orientation, said decorative head cap being rotatably positionable when said fastener is installed at an arbitrary rotational position in order to orient said visual information content in a desired orientation.

**23**. The fastener of claim **22**, wherein said head cap is configured for incremental rotation in a controlled manner through a predefined set of positions relative to said fastener body.

**24**. The fastener of claim **22**, wherein said incremental rotation is provided by opposing inter-engaging ratchet teeth.

**25**. The fastener of claim **22**, wherein said ratchet teeth are annularly oriented.

**26**. The fastener of claim **25**, wherein said ratchet teeth are provided by opposing inserts that are respectively mounted on a body bearing surface of said head cap and a head cap bearing surface of said fastener body, said inserts having opposing annular teeth.

**27**. The fastener of claim **25**, wherein said ratchet teeth are provided by annular ratchet teeth on a body bearing surface of said head cap and an insert with opposing annular ratchet teeth that is mounted on a head cap bearing surface of said fastener body.

**28**. The fastener of claim **25**, wherein said head cap includes a head cap base and a head cap stem that is received in a head cap receiving bore of said fastener body, said head cap receiving bore terminating at a head cap retaining shoulder and said head cap stem being secured to said head cap retaining shoulder by way of a head cap retainer, said head cap being arranged for at least partially longitudinal displacement with respect to said fastener body so as to allow said ratchet teeth to be separate and re-engage while rotating said head cap.

**29**. The fastener of claim **28**, wherein longitudinal displacement is provided by virtue of a spring member disposed between said head cap retaining shoulder and said head cap retainer.

**30**. The fastener of claim **28**, wherein said longitudinal displacement is provided by virtue of said head cap retainer comprising one or more integrated flanges on one or more flexible prongs of said head cap stem, said one or more integrated flanges releasably engaging said head cap retaining shoulder.

**31**. The fastener of claim **24**, wherein said ratchet teeth are longitudinally oriented.

**32**. The fastener of claim **31**, wherein said ratchet teeth are provided by longitudinal ratchet teeth on a head cap receiving bore of said fastener body and opposing longitudinal ratchet teeth on a stem of said head cap.

**33**. The fastener of claim **32**, wherein said ratchet teeth on said stem of said head cap are formed on one or more flexible tabs on said stem, and wherein said head cap is selectively rotatable by virtue of said ratchet teeth on said head cap receiving bore causing deformation of said one or more flexible tabs as said head cap is rotated.

**34**. The fastener of claim **31**, wherein said ratchet teeth are provided by longitudinal ratchet teeth on a base of said head cap and opposing longitudinal ratchet teeth on a stem of said head cap, said head cap base being separate from said head cap stem, and said head cap stem being fixed against rotation relative to said fastener body.

**35**. The fastener of claim **34**, wherein said head cap base and said head cap stem are retained together by one of (1) a retainer ring or (2) one or more flanges.

**36**. The fastener of claim **34**, wherein said head cap is selectively rotatable by virtue of deformation of said ratchet teeth that allows said head cap base base to rotate relative to said head cap stem.

**37**. A fastener comprising a metal fastener body and a metal head cap mounted on said body using a metal head cap retainer.

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